Strategic Issues for Japanese Electric Utilities in the Telecommunications Business: Can Utilities Light Up the Information Superhighway?

by

Takaaki Takeuchi

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Submitted to the Department of Electrical Engineering and Computer Science
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Abstract

The question central to this thesis is whether Japanese electric utilities should consider contributing to the construction of the National Information Infrastructure (NII). This thesis analyzes the past business experiences of Japanese electric utilities in the telecommunications market and examines how they can play a role in constructing the future Japanese NII.

The NII, the so-called "information superhighway", is a proposed nationwide information and telecommunications infrastructure that can transmit various kinds of data (voice, file data, video image, and broadcasting information). Broadband telecommunication technology using optical fiber cable is crucial to the construction of the NII. This technology can transmit data uniquely, without interference from the electromagnetic waves emanated from power lines, and electric utilities have installed optical fiber networks extensively for their internal use.

One Japanese utility has provided regional telephone service since 1985 when the telecommunications services market opened, but has experienced severe difficulties in expanding its number of subscribers. Two major restrictions cause this problem: limitation of the communication area, and limitation in interconnecting with an existing telephone service monopoly company. One fundamental problem is that the government allowed their business without first creating a coherent policy on local telecommunications competition. The utility requires a robust strategy to break through the existing situation.

Despite many political and technological uncertainties of the NII, the entry of Japanese electric utilities into the residential telecommunications services market will bring significant benefit to the utilities industry, to the telecommunications industry, to society, and to governmental policy, and therefore, utilities are well advised to play a role in the construction of the NII. A utility must consider three strategies simultaneously: telephone services as a core telecommunications business; utility-related services such as residential demand-side management; and non-utility services such as interactive multimedia services. A utility is recommended to initiate services where it can be a main player from the outset, and to initiate options as promptly and as thoroughly as possible because all opportunities are constantly interacting.

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Table of Contents

List of Abbreviations

AMR	Automated Meter Reading
AT&T	American Telephone and Telegraph
ATM	Asynchronous Transfer Mode
CAP	Competitive Access Provider
CATV	Cable Television
CTC	Chubu Telecommunications Co.
CTNet	Chugoku Telecommunication Network Co.
DDI	DDI Corp.
DSM	Demand-Side Management
EPRI	Electric Power Research Institute
FCC	Federal Communications Commission
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
HOTnet	Hokkaido Telecommunication Network Co.
HTNet	Hokuriku Telecommunication Network Co.
IDO	Nippon Idou Tsushin Corp.
IXC	Interexchange Carrier
JT	Japan Telecom Co., Ltd.
MPT	Ministry of Posts and Telecommunications
MSO	Multiple Systems Operator
NCC	New Common Carrier
NII	National Information Infrastructure
NTT	Nippon Telegraph and Telephone Corp.
OMP	Osaka Mediaport Corp.
OPGW	Optical Ground Wire
PCS	Personal Communication Service
PHS	Personal Handy-Phone System
POI	Point of Interface
PUC	Public Utility Commission
PUHCA	Public Utility Holding Company Act
QTNet	Kyushu Telecommunication Network Co.
RBOC	Regional Bell Operating Company
SEC	Securities and Exchange Commission
STNet	Shikoku Information and Telecommunication Network Co.
TEPCO	Tokyo Electric Power Co.
TOHKnet	Tohoku Telecommunication network Co.
TTNet	Tokyo Telecommunication Network Co.
TWJ	Teleway Japan Corp.

Chapter One

Introduction

1.1 Concepts

The national information infrastructure (NII), or the so-called "information superhighway", will be constructed worldwide within the next two decades, and is expected to yield tremendous economic values, provide many new job opportunities, and further enrich the daily life of all people. The definition of the NII is a nationwide infrastructure that will consist of: (1) thousands of interconnected and interoperable networks, (2) many kinds of information appliance (such as computers, televisions, and telephones), (3) information service software and databases, and (4) trained people who can build, maintain, and operate these systems.[1] To realize multimedia services that can deal with various kinds of data (voice, file data, video image, and broadcasting information), the emerging technology of broadband telecommunications using optical fiber networks is expected to play an important role in both backbone networks and in local loops. Furthermore, this technology will diminish the existing boundaries between industries such as telecommunications, broadcasting, publishing, computers, and other consumer appliances.

For example, Time Warner Cable, a major CATV company in the United States, plans to create a two-way full service network in Orlando, Florida, and to provide video-on-demand, telephone, and interactive multimedia services such as home shopping, education, and video games. They said that one reason they are going to enter the telephone business is that technology has given them an opportunity.[2]

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1 The National Information Infrastructure Frequently Asked Questions (FAQ) on World Wide Web in Internet defines this. It also says that the NII, in the future, will enable all Americans to get the information they need, when they need it and where they need it, for an affordable price.

2 In a lecture at MIT on November 16, 1994, Ms. Lisa Hook, Time Warner Inc., said that they were going to provide telephone service as a mid-term strategy towards a full service network. There were three reason why they were interested in telephone service: Technology has given them an edge, packaging boosts all their businesses, and incremental capital yields incremental revenues.

Technology has also presented an opportunity to electric utilities. Electric utility companies have introduced optical fiber technology in their internal telecommunication networks to control their facilities and improve operations. However, the use of these networks for their own demand is very small compared with total capacity, and therefore the extra capacity of the fiber can be utilized for other purposes and turned into some revenue. A utility company can expect to share the cost of constructing their internal network, and also to generate new business opportunities by organizing two-way communication networks between the utility company and its customers, such as with demand-side management (DSM), automated meter reading(AMR), and customer communication systems that provide energy information to customers.

These opportunities can reduce the total operating costs of a company and create a competitive advantage in their core business, which is likely to be further deregulated along with the telecommunications industry. It can therefore be said that electric utilities have strong technological potential and economic incentives to contribute to constructing the NII, and to compete in the local telecommunications market with local exchange carriers, CATV companies, personal communication services providers and other telecommunications companies.

1.2 Background

The Japanese Ministry of Posts and Telecommunications (MPT), in 1985, privatized the government-owned telecommunications monopoly, the Nippon Telegraph and Telephone Public Corporation (NTT), and allowed for new companies to enter the telecommunications service market. Since this deregulation, several new common carriers (NCCs) have emerged. Nine of ten electric utility companies have entered in the telecommunications business with their partially owned telecommunication subsidiaries. For example, the Tokyo Telecommunication Network Company (TTNet), which was established by the Tokyo Electric Power Company (TEPCO) in 1986, provides regional telecommunications services (such as private leased circuit services and local telephone service) among 459 cities and communities in the Tokyo metropolitan area [TTNet, 1994b].

In the long distance telecommunications market, three NCCs have been vigorously competing with NTT and expanding their market share rapidly, and as a result, consumers have come to enjoy lower rates for long distance calling. Compared with successful competition among long distance carriers, however, regional NCCs affiliated with electric utilities have not yet gained enough power to compete with NTT as expected, although almost nine years have passed since the entries.[3]

In the United States, on the other hand, it is not easy under current regulations for utility companies to enter the telecommunications business freely and enjoy new opportunities. The Public Utility Holding Company Act of 1935 restricts many electric utilities holding companies from joining a new business other than their core business, from the viewpoint of protecting utilities customers. However, several utilities are now conducting pilot projects of energy management information systems, in which they connect their telecommunications networks with residential customers to try advanced demand-side management. Furthermore, some are willing to expand these projects to the telecommunications business, with the expectation of the future deregulation both in telecommunications and utilities firms towards the NII. They believe they can play a significant role in constructing the NII with their optical fiber networks. At present, there is no clear answer as to whether they should enter the telecommunications business.

1.3 Objectives and Methodology

The central question to this thesis work is whether Japanese electric utilities can contribute to constructing the NII. As I analyze the current situation of the regional telecommunications service in Japan, however, I find that they have already faced many issues to set their telecommunications business in the right direction. Given that the NII will be based on the competitive market position of private companies, Japanese electric utilities will not be able to participate fully in the NII unless they can develop successful businesses in current regional telecommunications services markets.

The objective of this thesis is to answer the following questions through analysis of technological, political and managerial aspects of electric utility delivery of the NII services.

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[3] Market share of TTNet in regional telephone service is 0.04%. The rest is occupied by NTT.

1) What are the best strategies for Japanese utilities for future success in the regional telecommunications market?

2) What kind of problems can they expect to encounter in the technological, managerial, and political senses?

3) How should they approach these problems?

I focus on TEPCO and TTNet because the current scale of their backbone networks is the largest among all utilities and their service areas cover the most industrialized areas in Japan. To analyze corporate policy and governmental policy, comparison is conducted between developments in Japan and the United States.

Most of my research is based upon written materials and interviews with personnel from the appropriate companies.

1.4 Structure

The overall structure of this thesis is shown in Figure 1.4-1. Generally, the contents discussed in each chapter lie in either the telecommunications or utilities fields, or both. In chapter 2, the history of the Japanese telecommunications market since the 1985 deregulation is presented in overview. Then, the present telecommunications businesses of TEPCO are analyzed and the problems discussed in chapter 3. The telecommunications businesses of utilities in the United States are also discussed in chapter 3 to make a comparison. Finally, in chapter 4, future strategic options for Japanese electric utilities and possible problems are presented and analyzed in detail. This analysis is based on (1) a comparison of strategies of the telecommunications business in Japan and the United States, (2) a comparison of governmental policies for both the long distance and regional telecommunications firms, and (3) possible options of strategic application and regulation.

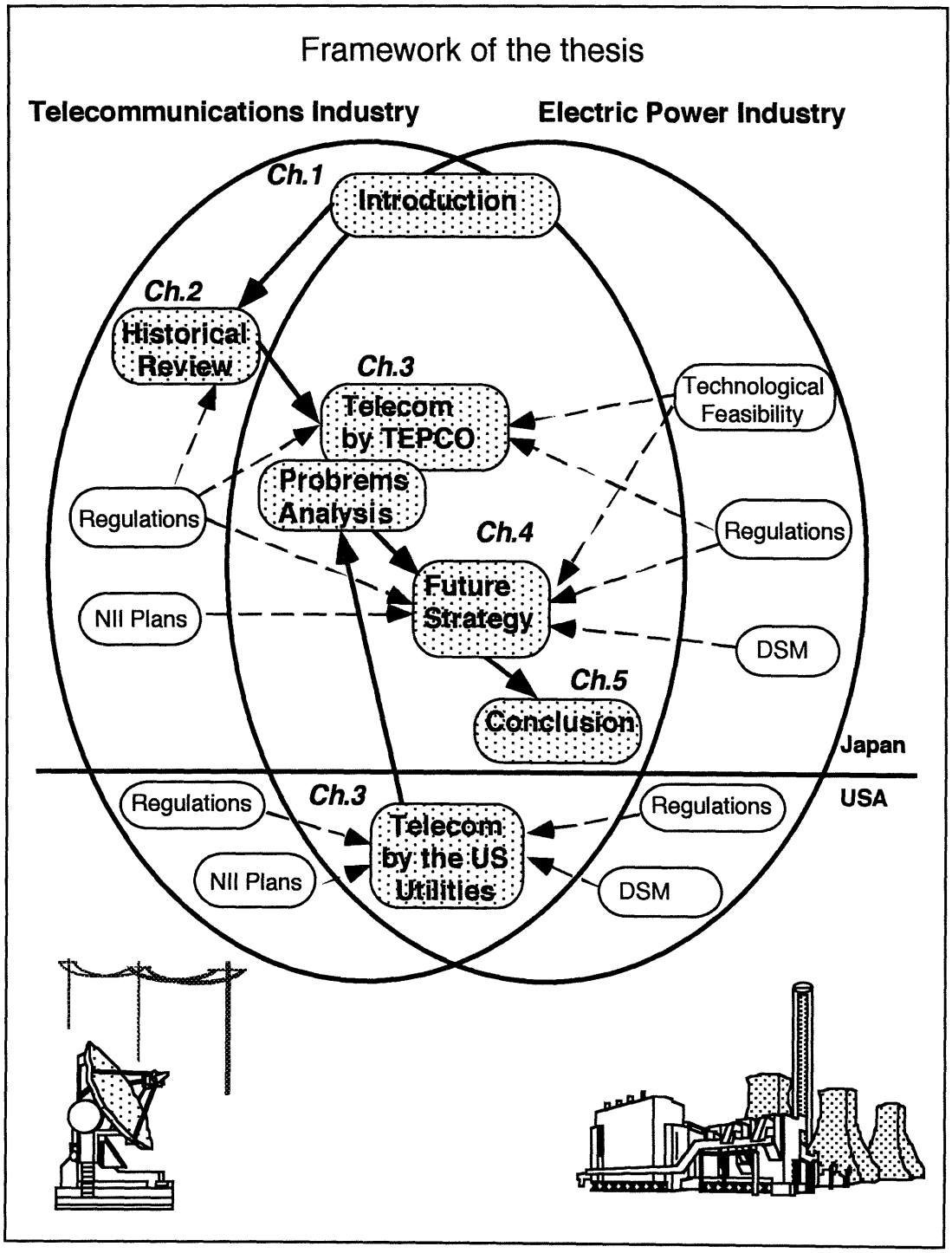


Figure 1.4-1 Structure of the Thesis

Chapter Two

A Review of the Telecommunications Service Market in Japan

The Japanese telecommunications market was opened in 1985, accompanied by the privatization of the Nippon Telegraph and Telephone Public Corporation (NTT), a government-owned monopoly in the domestic telecommunications market. This occurred just one year after the 1984 divestiture of AT&T in the United States. Unlike the case of AT&T, NTT was not broken up into regional service companies and a long distance company. Since Japanese deregulation, many new common carriers (NCCs) have entered the market and now compete with the telecommunications giant, NTT. A summary of the deregulation history in the telecommunications service in Japan is shown in Figure 2-1. In this chapter, a general history of Japanese telecommunications service market after the deregulation is reviewed.

2.1 Before the Privatization of NTT

Until the 1985 privatization of NTT, the Japanese telecommunications business was regulated as a monopoly. Telephone service started in 1890 as a governmental service, which in 1953 was reformed into a government-owned public corporation, NTT. Three laws were enacted in this reform: the Wire Telecommunications Law, the Public Telecommunications Law, and the Nippon Telegraph and Telephone Public Corporation Law. These laws not only denied new entrants to the telecommunications business but also restricted the establishment of private networks or in-house communication [Tomita, 1992].

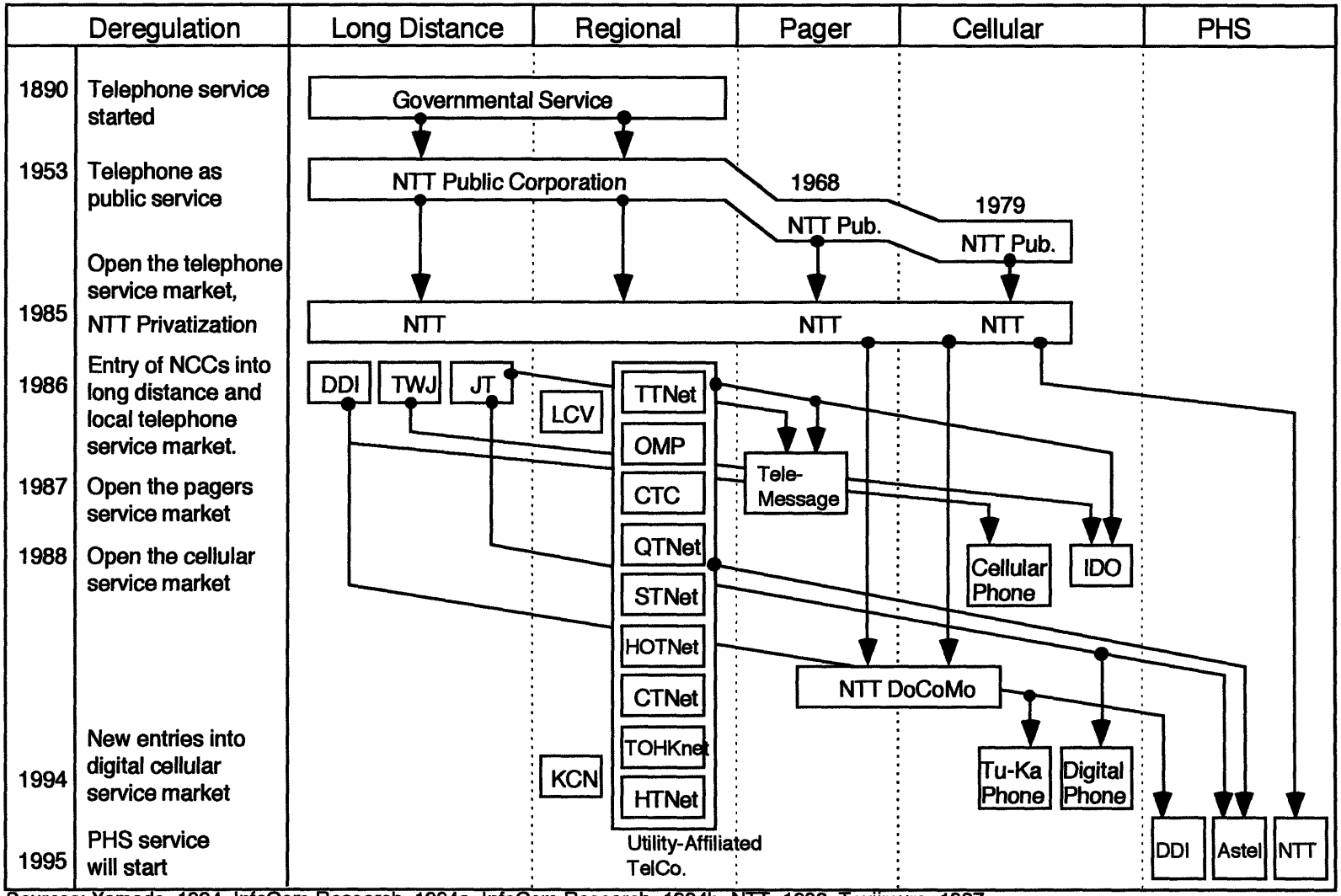
Jill Hills has categorized the reasons for the regulation of private enterprises roughly into 'social' and 'economic' [Hills, 1986, p.5]. In this sense, the Japanese NTT case belonged in both categories. In a social sense, it was critical to provide telephone

service as a "universal service", where everyone could enjoy the service without discrimination, from urban to rural areas regardless of the investment. In the economic sense, it could be justified by the concept of natural monopoly, in which it would be inefficient to have more than one supplier in a market because of high economies of scale. Immediately after the 1945 end of the Second World War, the demand for telephone service increased with rapid economic growth, but NTT's supply was limited. A governmental document explains that it was necessary to meet the tremendous demand for telecommunications by unified management of limited resources, and this became the main objective of the monopoly system [MPT, 1989].

2.2 Deregulation in 1985

The installation backlog was cleared up in 1978 and the nationwide installation of a direct dialing system was completed in 1979, which were two major objectives for the Japanese telecommunications policy [NTT, 1986; MPT, 1989], and therefore, the reason for the monopoly system was weakened. The market for telephone services had matured and the growth rate held at only three percent per annum in the 1980s, down from 21% between 1965 and 1975 [Hills, 1986, p.104]. Furthermore, the increasing needs of more diversified telecommunications services (such as data communications) pressured policymakers and NTT to open the market to competitors. Two laws enacted on April 1st, 1985, created a drastic reform of the telecommunications industry. One was the Telecommunications Business Law, which replaced the Public Telecommunications Law and allowed new entries into the telecommunications market. The second was the NTT Corporation Law, which replaced the NTT Public Corporation Law and defined NTT's organization such as objectives and structure. Unlike the case of AT&T in the United States, the idea of breaking up the NTT into regional operating companies and a main body dealing with research and long-distance calls was shelved at that time.[1]

1 The issue of NTT's privatization was first raised by the Second Ad Hoc Commission on Administrative Reform, a commission appointed by the Prime Minister to review the government deficits; they recommend a reformation of governmental administration. This original report to the government recommended the break-up of NTT. This idea was finally deleted largely for political and bureaucratic reasons. See [Hills, 1986, p.120 - p.156].



Sources: Yamada, 1994, InfoCom Research, 1994a, InfoCom Research, 1994b, NTT, 1993, Tsujimura, 1987.

Figure 2-1 Deregulation and Players in Each Telecommunications Service Market

The 1985 Telecommunications Business Law divided telecommunications businesses into two categories: Type I and Type II. Type I carriers provide telecommunications services through their own circuits and facilities, while Type II carriers provide services through leased facilities by Type I carriers. NTT is categorized in Type I. Entrants in Type I business must obtain permission from Ministry of Posts and Telecommunications (MPT).

2.3 New Entrants into the Telephone Market

New common carriers (NCCs), which means new entrants into the Type I business, emerged immediately following deregulation. As of April, 1994, there are three NCCs in long distance services and eleven NCCs in regional telecommunications services. The domestic telephone service and leased circuits service market in FY 1992 is shown in Table 2.3-1. The total market size of telephone service was 4.9 trillion yen ($49 billion) in FY 1992 and the growth rate compared to the previous year was 0.8 % . The market share of all NCCs grew 7.8%, and revenues grew at the rate of 21.6%. The leased circuits service market was 530 billion yen ($5.3 billion) and the growth rate was 14%. The market share of NCCs was 13.9% and the revenue grew at the rate of 17.3% per annum [InfoCom Research, 1994b, p.143]. The telephone service market itself has already matured, but NCCs are expanding their market share gradually both in telephone service and leased circuits service.

Table 2.3-1 Market of Telephone and Leased Circuits in Japan

(Revenue: billion yen)

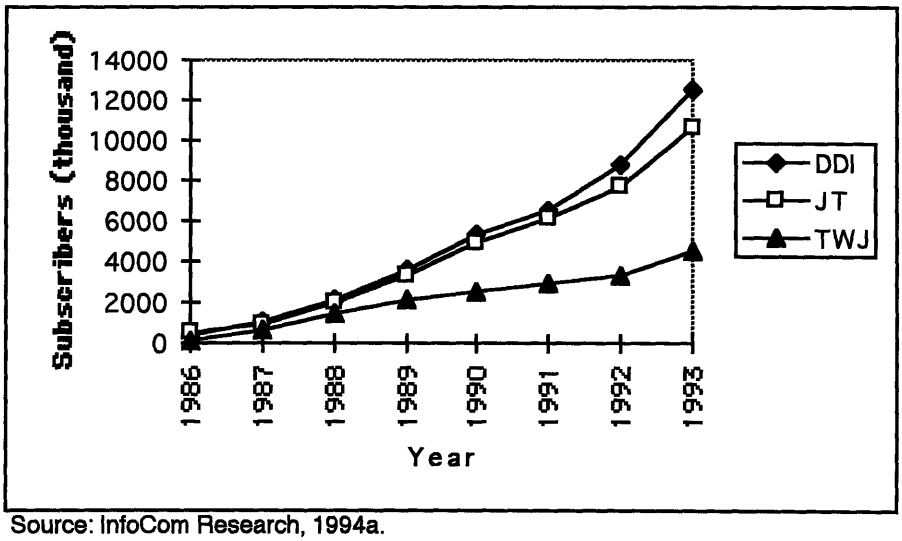
	Telephone			Leased Circuit		
	Revenue	Annual Growth	Share	Revenue	Annual Growth	Share
NTT	4576.7	-0.89%	92.11%	455.9	13.58%	86.05%
NCCs	391.9	21.63%	7.89%	73.9	17.30%	13.95%
Total Market	4968.6	0.58%	1	529.8	14.08%	1

Source: InfoCom Research, 1994b.

2.3.1 Competition in the Long Distance Service Market

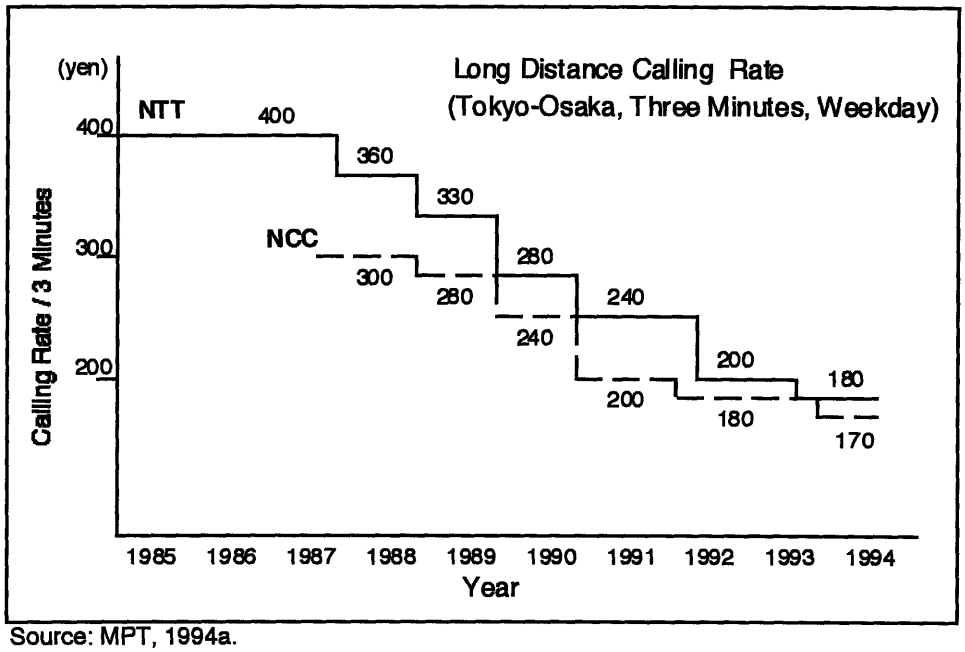
In April 1985, MPT allowed three new competitors to enter the long distance carrier business. One was DDI Corp. (DDI), which was affiliated with Kyocera, a ceramics company, and others such as Sony Corp. and Mitsubishi Corp. The second was Japan Telecom Co., Ltd. (JT), which was formed by the former Japan National Railways. The last to enter the market was Teleway Japan Corp. (TWJ), which was affiliated mainly with the Japan Highway Public Corp., the Ministry of Construction and Toyota. DDI decided to establish microwave networks, while the other two planned to lay optical fiber networks along their existing rights of way. All three NCCs launched leased circuit and telephone services in 1986 and in 1987, respectively, between Tokyo and Osaka, the most used route in Japan, and since then, they have been expanding their networks nationwide.

Currently, DDI and JT are successfully increasing the number of their customers and expanding their network nationwide, while TWJ has been struggling to expand its market share. Figure 2.3.1-1 shows the growth in the telephone subscribers of long distance NCCs from 1986 to 1994. As of March 1994, the total number of the subscribers of all long distance NCCs is 27 million, which is 47% of the number of NTT telephone subscribers (58 million). In fact, regarding the traffic share in the most used route, between Tokyo-Nagoya-Osaka, the total traffic of the three NCCs surpassed that of NTT after 1991, and is currently 54.4% [InfoCom Research, 1994a, p.29]. In addition, the rates for long distance calls have been decreasing significantly. The long distance rate between Tokyo and Osaka was 400 yen ($4) per three minutes by NTT before the privatization, and it is currently 170 yen by NCCs as of March, 1994 (Figure 2.3.1-2) [MPT, 1994a, p.8]. Because the price generally decreases almost 60% compared with that in the monopoly era of NTT, it can be said that deregulation has brought significant benefits for consumers with regard to long distance calls.



Source: InfoCom Research, 1994a.

Figure 2.3.1-1 Growth in Telephone Service Subscribers of Long Distance NCCs



Source: MPT, 1994a.

Figure 2.3.1-2 Changes in Rate of Long Distance Calling

NCCs' network and NTT's network are interconnected at a point of interface (POI). The number of POI is limited to one per prefecture. With regard to pricing, an end-to-end pricing system was introduced in November, 1993, and NCC became able to set end-to-end prices. Before the change, price was determined by totaling prices of the NCC for the long distance area between POIs and NTT for the local access networks connecting to POI. Because of this change, the NCCs can now provide more flexible pricing. The access charge system, which had been used in the United States, was introduced in Japan in April 1994.

2.3.2 Competition in the Regional Telecom Service Market

With the 1985 deregulation, MPT also opened the regional telecommunications market to NCCs. Soon after deregulation, four NCCs entered the market.

1) Tokyo Telecommunication Network Co. (TTNet), which was affiliated mainly with Tokyo Electric Power Co. (TEPCO), Mitsui Corp., and Mitsubishi Corp. TTNet began private leased circuit services in November 1986, and regional telephone service in May 1988, covering the Tokyo metropolitan area.

2) Osaka Mediaport Corp. (OMP), which was affiliated mainly with Kansai Electric Power Co. and Osaka Prefecture. OMP began private leased circuit services in March 1987, covering Osaka, Kyoto, and other cities in the Kansai area.

3) Chubu Telecommunications Co. (CTC), which was affiliated mainly with Chubu Electric Power Co., Mitsui Corp., and Mitsubishi Corp. CTC began leased circuit services in May 1988, covering the Chubu area including Nagoya.

4) LCV Corp., a CATV company in Nagano, began private leased circuit service around Suwa City in Nagano prefecture.

The first three are NCCs affiliated mainly with electric utility companies, while the fourth is a local CATV company. The NCCs introduced regional telecommunication services by using their independent optical fiber networks other than NTT's subscriber networks.

Following these frontiers, the remaining six electric utilities (other than Okinawa Electric Power Co.) have established regional NCCs: Kyushu Telecommunication Network Co. (QTNet) by Kyushu Electric Power Co., Shikoku Information and Telecommunication Network Co. (STNet) by Shikoku Electric Power Co., Hokkaido Telecommunication Network Co. (HOTnet) by Hokkaido Electric Power Co., Chugoku Telecommunication Network Co. (CTNet) by Chugoku Electric Power Co., Tohoku Telecommunication Network Co. (TOHKnet) by Tohoku Electric Power Co., and Hokuriku Telecommunication Network Co. (HTNet) by Hokuriku Electric Power Co..

Adding a new entrant by a CATV company, as of July, 1994 there are eleven regional NCCs. Almost all regional NCCs are utility-affiliated. Among these, only TTNet provides local telephone services. Almost all NCCs provide only leased circuit services. CTC, STNet, HOTnet and TOHKnet have announced that they will start ISDN service in 1996, which will at first be used by utility-affiliated PHS service companies [Nikkei New Media, 1995].

The largest advantage of these NCCs would be that they or their parents have already installed their own optical fiber networks for the purpose of core businesses such as electric utility or CATV, and therefore, they can expand their network infrastructure cost-effectively. Table 2.3.2-1 shows the length of optical fiber networks of telecommunications companies [Yamada, 1994, p.76]. NTT has laid 110,000 km of fiber cables nationwide, but TTNet has laid 25,000 km just in the Tokyo metropolitan area. Other utility-affiliated NCCs have also installed a significant length of fiber networks. Because these NCCs employ many skillful optical fiber network engineers, their technological potential should be strong.

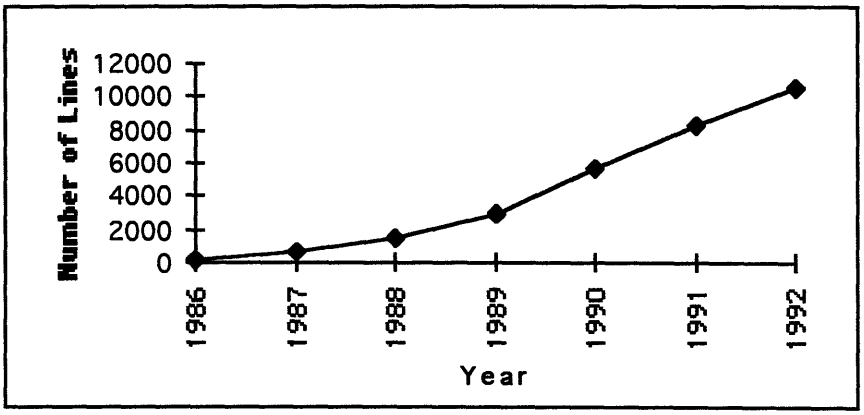
Figure 2.3.2-1 shows the growth in the number of private leased circuits provided by all utility-affiliated regional NCCs. The number was 10,574 as of March 1993, and is growing at the rate of 28.8% per annum [TTNet, et al, 1993, p.3-p.4]. The total number of leased circuits in Japan is 1,028,308, in which NCCs occupy 16,004. Therefore the share of circuits occupied by utility-affiliated NCCs is just 1.02% of total circuits in Japan, but 66% among all NCCs. The revenue of regional NCCs in the leased circuits

service is 54.2 billion yen in FY 1992, which is 9.7% in the total market, and the annual growth rate is 14%.[2] Because the share of revenue is more than the share of the number of circuits, it can be said that the utility-affiliated NCCs are efficiently expanding their market.

Table 2.3.2-1 Length of Optical Fiber Networks

Company	Service		Length
	Long Dis	Local	(km)
NTT	*	*	119,681
TTNet		*	25,340
JT	*		7,500
OMP		*	7,215
CTC		*	6,055
TWJ	*		5,000
QTNet		*	3,393
STNet		*	1,847
HOTNet		*	1,500
CTNet		*	1,609
HTNet		*	415
TOHKnet		*	300
LCV		*	100

Source: Yamada, 1994.



Source: TTNet, et al, 1993.

Figure 2.3.2-1 Growth in the Number of Leased Circuits by Regional NCCs

2 These numbers are derived from the data in the following materials: [InfoCom Research, 1994. p.30], and [MPT, 1994, p.10].

With regard to the regional telephone service, the only competitor is TTNet. The number of subscribers was 10,200 as of March 1994 [InfoCom Research, 1994a]. Information is unavailable about the number of subscribers of NTT that exist within the service area of TTNet. If it is reasonable, for very rough analysis, to divide the total subscribers of NTT (58.8 million) in proportion to the population of the area, it will be about 20 million.[3] Therefore TTNet has obtained only 0.05% of total potential customers in six years. The revenue of telephone service by TTNet in FY 1993 was 1.6 billion yen ($16 million) and growing at 36.7% per annum, but the market share is just 0.03% of total telephone market, 4.9 trillion yen ($49 million). After all, it can be said that the competition for regional telephone service has not been done well, compared with the successful competition in the long distance service. This situation is analyzed in chapter three.

2.4 Current Telecom Market for New Services in Japan

Several additional telecommunications services other than basic telephone service have been deregulated since the privatization of NTT. The market size and annual growth of the domestic telecommunications service in FY 1993 are shown in Table 2.4-1 [InfoCom Research, 1994a, p.27]. Among these services are the rapidly expanding wireless telecommunications markets for cellular telephone and pagers services, of which annual market growth is 35.1% and 24.2% respectively. An additional wireless service, the Personal Handy Phone System (PHS), will be started in 1995. This is known as the Personal Communication Service (PCS) in the United States. On the other hand, seeking to calculate the multimedia markets related the NII, companies of various industries are preparing to enter markets for new type of telecommunications services. Among them, the CATV industry is being highlighted because of the potential of its residential multimedia networks and the recent deregulation.

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3 The total 1990 population in Japan was 123.6 million, while the population in the nine prefectures covered by TTNet was 43.1 million. Therefore, the proportion of population was 34.8%. Data from [Management and Coordination Agency, 1993, p.39].

Table 2.4-1 Domestic Telecommunications Service Market (1993)

(Market Size: billion yen)

	Telephone	Leased Circuit	Cellular / Mobile	Marine	Pager	Others	Total
Market Size	4,932	565	630	16	222	498	6,863
Annual Growth	-0.7%	6.8%	35.1%	12.7%	24.2%	9.8%	3.8%

Source: InfoCom Research, 1994a.

2.4.1 Competition in the Wireless Telecommunications Market

2.4.1.1 Cellular Service

The Deregulation Process

Cellular phone service was initiated by NTT in 1979 as a monopoly service, and was deregulated in 1988 [InfoCom Research, 1994b]. At that time, MPT restricted the number of service providers in a region to two, which included NTT [Yamada, 1994]. Therefore, there was only one slot for NCCs to enter the cellular service in a region, but two NCCs were competing to enter the cellular business. To solve this issue, MPT finally divided the whole of Japan into two areas. Nippon Idou Tsushin Corp. (IDO) was allowed to launch business in the Tokyo metropolitan area and Nagoya area, while Cellular Telephone Group received a business license in the rest of the area. The former was founded mainly by the Toyota Motor Co. and a long distance carrier, TWJ. The latter company was founded by DDI, which was also a long distance carrier.

The second major deregulation was implemented in April, 1994, and the three critical changes occurred [Iizuka, 1994].

1) Cellular sales were deregulated.

Handsets were allowed to be purchased rather than leased. The suggested price of a handset is from 90,000 yen ($900) to 130,000 yen ($1,300). The market prices are less than these suggested prices.

2) Two additional NCCs were allowed to enter the digital cellular market.

The Tu-Ka Cellular Communications Group and Digital Phone Group entered the digital cellular phone business. The former was founded primarily by Nissan Motors and DDI, and the latter was founded by Japan Telecom (JT), which is the third long distance carrier. As a result, five groups currently exist in the Japanese cellular service business. Three old groups provide both analog and digital cellular service and these two new groups provide only digital service. Table 2.4.1.1-1 shows current service providers of the cellular phone.

Table 2.4.1.1-1. Cellular Service Providers

	Analog	Digital (800 MHz)	Digital (1.5 GHz)
NTT Docomo Group	*	*	*
IDO Group	*	*	
Cellular Group	*	*	
Digital Phone Group			*
Tu-Ka Phone Group			*

Source: Iizuka, 1994.

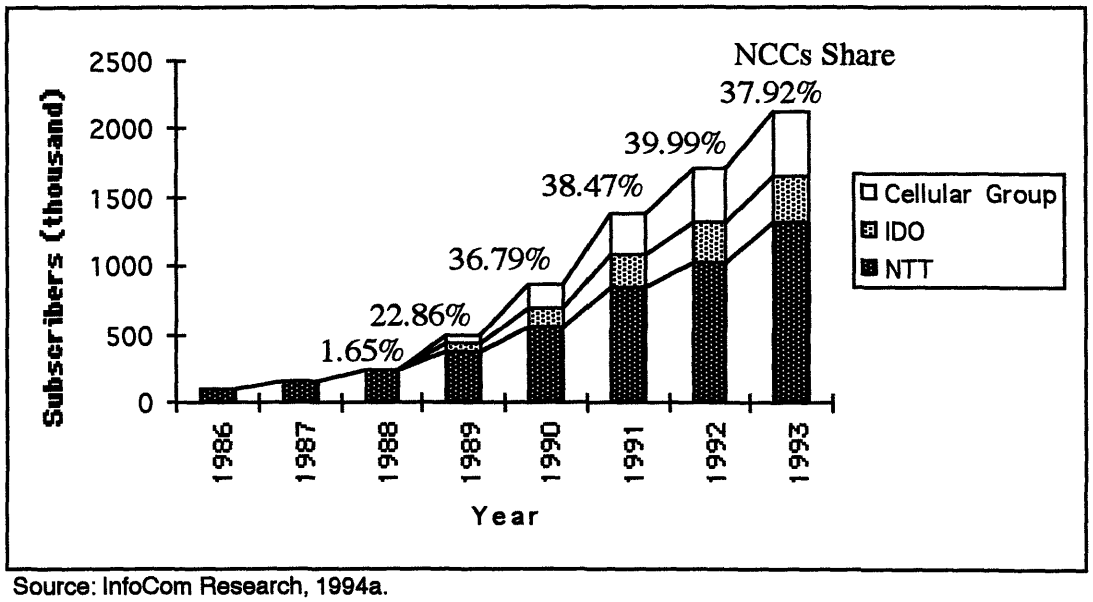
3) Significant rate cut was approved.

Each cellular provider was allowed to introduce a low-rate system other than the existing standard rate system. In the standard rate system, the basic charge is around 8,300 yen ($83) and the three-minute calling charge is 130 yen ($1.3) to 260 yen ($2.6). In the new low rate system, basic charge is about half the standard system but the three-minute calling charge is twice. New customers who subscribe after this deregulation tend to choose the low-rate system.

Current Market Size

Figure 2.4.1.1-1 shows the growth in the number of cellular customers. There were 2.1 million cellular phone subscribers in Japan as of March 1994 [InfoCom Research, 1994a], with a market penetration of 1.7% of the total population. This number is small relative to that of the United States, where 5% of total population use cellular service [Gross, 1994]. Because of the still relatively high price for service and

handsets, most customers are business users. However, following the second deregulation in April 1994, mentioned above, the cellular market in Japan is currently expanding dramatically.[4] MPT forecasts that the number of subscribers of cellular phone service will reach 10 million by the year 2000 [National Trade Data Bank, 1994].



Source: InfoCom Research, 1994a.

Figure 2.4.1.1-1 Growth of Cellular Subscribers

2.4.1.2. Pager Service

The Deregulation Process

Pager service was also initiated by NTT in 1968 as monopolized service and deregulated in 1987 [InfoCom Research, 1994b]. As with the case of cellular, MPT restricted the number of service providers to two per region, including NTT [Yamada, 1994]. Therefore, there was room for only one NCC. The Telemessage Group, which was affiliated with JT, obtained their licenses.

4 761,000 cellular phones were newly subscribed in the April-September period, which far exceeded the 418,000 for the entire year to March. See [Fienberg, 1994].

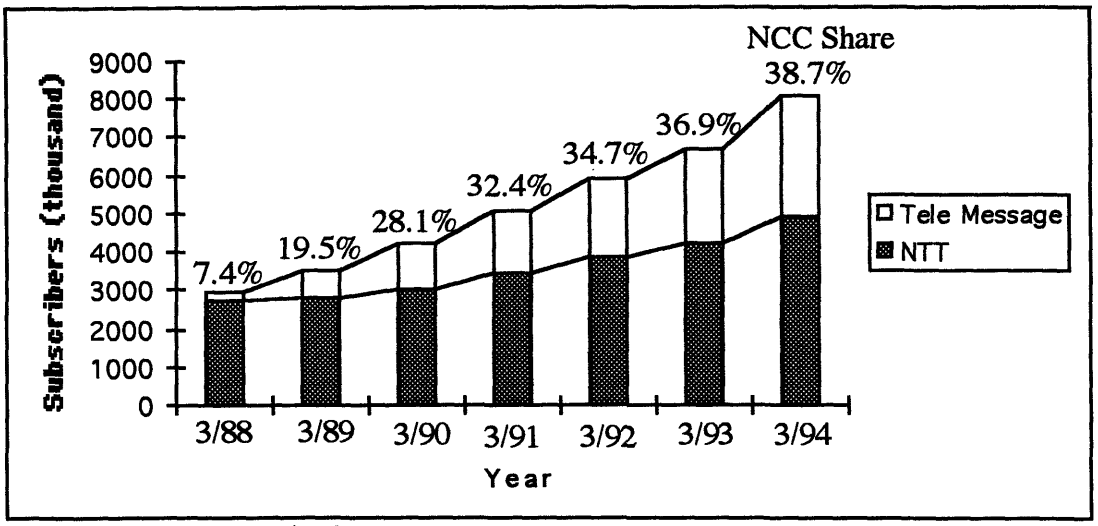
Current Market

Figure 2.4.1.2-1 shows the growth in the number of pager users. The number of total pager users in March 1994, was 8,063,900,[5] or, about 6.5% of the total population in Japan, and this number increased by 20.9% from the last year [InfoCom Research, 1994a]. As with the case of cellular, 80 ~ 90% of total customers are business users. However, 70% of the new 1993 customers were private users, and pager service is now rapidly penetrating among private users [MPT, 1994b]. Having a pager is getting a boom especially among female teenagers, and this social phenomenon in Japan is called the "Poke-Bell (Pager) Generation."[6]

The monthly rate for pager service is approximately 1,700 yen ~ 2,000 yen ($17 ~ $25), and this rate is decreasing gradually (31% during last 5 years) [InfoCom Research, 1994a]. Retail purchase of a pager is still regulated, but MPT will deregulate it in March, 1995. As a result, the pager market is expected to expand more rapidly among both business users and private users.

5 NTT's market share is 62% (4,520,000 customers) and NCC's market share is 38% (2,780,000 customers).

6 This growth phenomenon is said to be caused by following process:
- The number of families in which both parents work is increasing.
- Working parents give their children a pager as a way of urgent communication.
- Chatting among children. (The pager is no longer a simple beeping machine.)
- Finally, the pager becomes a fashion item among female teenagers.



Source: InfoCom Research, 1994a.

Figure 2.4.1.2-1. Growth of Pager Subscribers

2.4.1.3. PHS

A new telecommunications service, the Personal Handy Phone System (PHS), known in the United States as personal communication service (PCS), will be launched in Japan in 1995. PHS is a digital wireless telephone system that uses micro-cell technology. The big advantage of PHS is that prices of both handsets and service rates are much lower than those of existing cellular systems,[7] but it also has some weaknesses, such as limitations in mobility and service area [MPT, 1994e]. MPT issued policy statements for PHS in June and December 1994, seeing the completion of experimental services offered by NTT and other NCCs in some limited local city areas [MPT, 1994c, 1994d, 1994e]. Because of its low price and digital capacity, the PHS is expected to penetrate rapidly into the private users market, and not only current telephone service companies but also many private leased circuits providers have expressed interest in this PHS business.

7 The price of handsets is expected to be under $500, and the airtime rate will be around 30¢ to 50¢ per three minutes. These prices are about 50% of those for the current cellular system. See [MPT, 1994c, 1994d, 1994e].

However, MPT suggests in a policy statement for PHS that the number of providers in a region must be no more than three [MPT, 1994c]. The companies who expressed interest in this business have organized into three groups: (1) NTT Central Personal Communications Network Group, which is a group of newly established subsidiaries of NTT for PHS business, (2) DDI Group, which is a group of subsidiaries of DDI, and (3) Astel Group, which is a joint venture of more than ten companies, and which includes regional NCCs (such as TTNet and OMP), a long distance NCC (JT), and trading companies (such as Mitsubishi Corporation). The first two groups use NTT's ISDN network as the backbone of their PHS service. The last group, Astel group, initially planned to use regional telecommunications networks laid by utilities-affiliated NCCs, but they gave up the idea in some regions because the individual networks have not yet been well organized compared with NTT's networks, which will be a strong disadvantage at initial startup. All groups are going to start PHS services in the summer of 1995.

MPT forecasts that the PHS market will grow to $25 billion, assuming that ten million terminals will be sold within ten years [Kageki, 1994]. MPT and NTT also expect a synergy effect in which the cellular market will continue to grow as the PHS market expands [NTT, 1994]. Meanwhile, the service rate and the price of cellular and pager devices are rapidly decreasing, as mentioned in the previous sections, which might slow down the initial penetration of new PHS service, or vice-versa. Whatever the results are, PHS will have strong impact on the existing wireless telecommunications market

2.4.2 The NII, Multimedia, and CATV Industry

Japan's NII concept was first launched in 1990 with NTT's "Service Vision for the 21st Century", which announced that NTT would start a project to connect households with optical fiber networks by the year 2015 [Global Telecom Report, 1992; New Era Japan, 1994], with total investment of 45 trillion yen ($450 billion), in preparation for future multimedia communication [Nishigaki, 1994]. This means that NTT will shift directly to Fiber to the Home (FTTH) by 2015, rather than Fiber to the Curb (FTTC) which is the dominating idea in the United States. In May 1995, MPT announced an ambitious schedule to link every home and office in Japan with optical fiber

networks by the year 2010, at an estimated cost of 33 trillion yen to 53 trillion yen ($330 billion to $530 billion) [MPT, 1994f]. It said also that the projected market size of multimedia industries is 123 trillion yen ($1.23 trillion) by the year 2010. MPT expected that the NII will be constructed fundamentally by private capital through fair competition. Currently, it is still unclear who will build the Japanese NII and how it will be built, and furthermore, the objectives of the construction have not been thoroughly discussed in Japan. There is also no concrete definition of terms (e.g. multimedia and national information infrastructure) and the market estimation will change depending on the definition of multimedia.

Despite these uncertainties, many industries are showing interest in the coming digital multimedia market. Not only ordinary telecommunications providers but also CATV companies, electronics vendors, entertainment industries, and trading firms plan to conduct trials of experimental multimedia services beginning this year, 1995, to confirm new business opportunities [Tanabe and Watanabe, 1994]. Table 2.4.2-1 shows current experimental service projects in Japan. While projects by NTT and MPT are using FTTH architecture, other projects are expected to adopt the FTTC style, mainly because of the need to avoid costly installation of optical fiber cable for residential customers.

Table 2.4.2-1 Experimental Projects regarding Multimedia Services in Japan

Initiator	Objectives	Major Applications	Major Technology
MPT (Government), PNES	Trials with FTTH	VOD, TV Telephone	Analog / Digital VOD
MPT (Government), BBCC	Feasibility Study of B-ISDN	Multimedia Home Shopping, Education	ATM
NTT	Multimedia Trials on NTT's ATM Network	127 Plans - VOD, Interactive TV, Game	ATM, IP Routing, Digital VOD
CATV operators, Utilities	Future CATV Business	CATV-telephone, Internet, VOD	Fiber/Coax, CATV-telephone, Dig. VOD
Local Governments	Local Information Infrastructure	Electronic City Hall, Educational VOD	Fiber/Coax, ATM. Digital VOD

PNES: Association for Promotion of New Generation Network Service
BBCC: Broadband-ISDN Business Chance and Culture Creation
VOD: Video on Demand
Source: Tanabe and Watanabe, 1994

Among the potential players in the multimedia industries, CATV industry is the most prominent. However, compared with the United States, the Japanese CATV industry has not grown well, mainly because of the specific regulations.

Japan's first CATV was installed in April 1955, which was just two years after the first broadcasting television service started [InfoCom Research, 1994b, p.501]. There were 9.2 million CATV subscribers in Japan as of April 1994 [InfoCom Research, 1994a, p.177]. The market penetration is about 20% of total households in Japan, which is relatively small compared with the United States where over 60% of households subscribe to CATV. In Japan, the number of subscribers of urban-type multi-channel CATV, the same type of CATV as in the United States, is 1.6 million, which is just 4% of households. A second type of CATV is installed in the blanket area of wireless broadcasting television and it does not have the capacity to carry extra channels. In fact, this type of CATV has been dominant in Japan until today. Overall, the CATV business has not been extremely successful.[8]

One reason why CATV has not penetrated the Japanese household market is because a multiple systems operator (MSO) such as Time Warner and TCI in the United States has not been allowed in CATV by Cable Television Broadcast Law. MPT had regulated CATV as a region-oriented service which brought profits only for the service region. However, MPT deregulated the industry, allowing MSOs to form and raising the ceiling of foreign capital up by one-third. Since this deregulation, several MSOs have been proposed, and two CATV giants in the United States, Tele-Communications Inc. (TCI) and Time Warner, plan to enter Japan with Japanese CATV companies. For example, TCI has set up a pilot CATV company with Sumitomo Corp., Japan's large trading company. They will launch interactive services first in Suginami Ward, Tokyo [Amor, 1994]. MPT expects that the subscribers of urban-type CATV will expand to 30 million and the penetration will be 60% as in the United States by 2010 [InfoCom Research, 1994a, p.177].

8 Among 140 CATV stations of urban-type, only 31 stations are in black. Total deficit in the market is 21 billion. [InfoCom Research, 1994a, p.177].

2.5 Regulatory Power of MPT

Did the 1985 deregulation of the Japanese telecommunications market really deregulate the market? The deregulation and privatization of NTT eventually provided MPT extended control, not only over NTT but also over all telecommunications service providers [Hills, 1986, p.120]. Governmental documents do not call it "deregulation", but "reform" of the telecommunications industry [MPT, 1989]. All the rules for service and competition are still strictly regulated by the MPT. The policy of MPT impacts not only the corporate activity of each service provider but the market size and trends of each telecommunications service as well. Therefore, the Japanese telecommunications market can be said to be "regulated competition."

I analyze the regulatory power of MPT after the "reformation" of telecommunications industry, focusing on Type-I telecommunications service.

2.5.1 The Principle of Regulation

Coordination of Industry

MPT has several important objectives in regulating the telecommunications service, such as promoting universal service and coordinating the usage of limited resources (e.g. frequencies for wireless communication). With regard to competition, MPT's regulation is designed to coordinate the whole telecommunications industry and moderate competition. The objective of coordination is to maintain the power balance among corporations. Therefore, competition is sometimes not for consumers but for suppliers. To realize this, there are two policies which MPT has been following since the reformation.

1) Weaken NTT's monopoly power

Since the privatization of NTT, MPT has still severely influenced NTT not to monopolize the market, and even tries to weaken their large market influence. It has failed to break up NTT into regional telecommunications companies and a long distance telecommunications company, but it always tries to divide NTT into smaller companies when it deregulates a new service (such as cellular or pager).

As shown in the previous sections, NTT Mobile Communication Network INC. (NTT DO CO MO) was a part of NTT which dealt with mobile communication service, but had to be separated from NTT by the policy of MPT in 1993. With regard to the new PHS service, MPT did not permit NTT to offer the PHS service by itself, and NTT decided to start the business through its subsidiary.

2) Help the Initial Growth of New Competitors

MPT has not only weakened NTT's monopoly power but also protects new entrants of NCCs and helps their initial growth. An example can be seen in the recent inter-access agreement with NTT and JT with regard to the new flame-relay service [Mizuno, 1994]. JT wanted to start a frame-relay service first in Japan, but they could not provide the service without interconnection with NTT because they had no subscribers circuits. JT had been negotiating with NTT since 1992 to allow connection, but NTT had consistently rejected the idea. After long and fruitless negotiation, JT asked MPT to order NTT to provide connection to them in October 1994.[9] Seeing this, NTT immediately accepted the inter-access, before the order of the minister was made. This was fundamentally an issue between two companies, but the minister and MPT can exercise regulatory power if the issue cannot be solved between NCCs and NTT, and this would bring severe disadvantage to the NCCs.

Another example can be seen in the latest PHS services preparation. To lead the success of the PHS service and to keep the competition fair among the companies, MPT proposed that NTT, which has the largest local telecommunications network, develop the interface with all PHS providers and to charge an equal access charge when PHS providers use the local networks of NTT.

9 Under Article 39 of the Telecommunications Business Law, the Minister of Posts and Telecommunications can make an arbitration when negotiation of inter access is difficult among telecommunications business providers. See [Mizuno, 1994; Communications Study Group, 1993].

In Japan, policy sometimes contradicts the surface attitude of promoting free competition. In this sense, Japanese markets do not have the free competition within an industry. Competition among companies trying to discriminate from others based on price or service is suppressed by high regulatory obstacles. The permission system is the key to industry control.

2.5.2 Factors of regulation

To coordinate moderate competition, MPT regulates primarily the following three factors.

1) Number of Competitors

The number of competitors in the new service market is usually regulated by MPT in order to insure that all new entrants can grow in an atmosphere of moderate competition. MPT allows entrance in the Type-I business by issuing a license. In most cases, the appropriate number of competitors in the new telecommunications service market is shown beforehand by MPT. As shown in the previous section by the case of the cellular phone, if there are more companies who want to do business in a new market than MPT expected, adjustment of the number of companies through negotiation is strongly recommended by MPT prior the licensing procedure.

2) Rate

The rate change for telephone calls is strictly supervised by MPT and cannot be changed without the permission of MPT. Compared with the United States, where telecommunications business providers have only to notify the Federal Communications Commission (FCC) of their new rate, service providers cannot flexibly manipulate their rating system as a business strategy. For example, in the case of the long distance calls market, NTT wanted to cut the price of long distance calling to compete with the coming NCCs by raising the price of local telephone service and reducing cross-subsidizing. However, MPT disallowed NTT's price raise for local telephone service, and as a result, it took five months for NTT to cut the price of long distance calling after the NCCs

entered the market with much lower prices. Indeed, this delay helped the initial growth of NCCs.

2.5.3 The Process of Allowing New Entrants: a Case in PHS

In the process of allowing new entrants in a new service, MPT normally exercises regulatory power by publishing business guidelines or a report which shows the MPT's will without making new laws. In the latest case of the Personal Handy-phone System (PHS), the MPT took three steps before the PHS service is offered.

1) Field Trials

Before starting a business, MPT recommended that potential PHS service providers offer PHS trials. Eight groups joined the trial. The purpose is to investigate the potential demand for PHS and customer preference for the service. MPT also checks the technological feasibility of the service and the technological levels of each group. The results are referred to when MPT selects the actual service providers.

A "Study Group for Evaluation of PHS Field Trials", organized by the MPT, concluded the results of field trials. In their report, service and technology aspects were mentioned based on the results, and the suggestion for service providers was also included. This is not a formal regulation, but MPT implicitly orders the service providers to follow the suggestions.

2) Business Guideline for PHS

Based on the results of the field trials and the reports by the "Study Group for Evaluation of PHS Field Trials", MPT publishes business guidelines for PHS service. The recommended number of providers is shown in the guideline, and in this stage, the companies who are willing to provide the service enter in negotiation to organize the appropriate number of service providers. Once they obtain a license, they cannot easily sell it or give up the business under the Article 16 and 18 of Telecommunications Business Law. [Communications Study Group, 1993] Unlike FCC, MPT tries to direct the details of PHS service such as suggested service rates, which in the United States is considered a business strategy.

3) Licensing

Finally, MPT's licensing is just a matter of procedure. Before reaching this stage, most coordination has been completed. The spectrum auctions held in the United States are not open for deciding the companies. The decision process for selecting companies is not clear on this point.

2.6 Summary

Since the 1985 reformation in Japanese telecommunications policy many companies have entered the telecommunications business, and competition has done well in many market segments, from long distance calls to wireless services, under the strict regulation of the MPT. However, competition in the regional telephone market has not been well made, although one NCC has been allowed to enter the market. As concern for the future NII and multimedia market increases, residential telecommunications and broadcast services are highlighted, and further growth of competition in the regional telecommunications market can therefore be expected to occur in the near future.

Chapter Three

Utilities in Local Telecom Competition: The Cases of TEPCO and US Utilities

In this chapter, the current telecommunications businesses of a Japanese utility, the Tokyo Electric Power Company (TEPCO), are presented and analyzed in detail. The telecommunications projects of utilities in the United States are also discussed to make a comparison.

3.1 Introduction to TEPCO as a Utility Company

The Tokyo Electric Power Company (TEPCO) is one of ten electric power companies in Japan, founded in May 1951. TEPCO serves the Tokyo metropolitan area, which includes Tokyo and eight surrounding prefectures: Kanagawa, Saitama, Chiba, Ibaragi, Tochigi, Gunma, Yamanashi and a part of Shizuoka. This area is Japan's most highly concentrated area of people, industry and government. TEPCO's customers currently number 23.7 million (20.8 million residential customers, 135 thousand commercial customers, and 2.7 million industrial customers). The annual revenue counts 4.7 trillion yen, yielded by 40 thousand employees [TEPCO, 1993]. The growth of revenue has slowed because of long-lasting recession, but the number of customers and the sales of electricity are still increasing constantly, especially in the residential market.

Regulations

Nine Japanese electric utilities, including TEPCO, were established in 1951 as private companies immediately following the Second World War, while the Okinawa Electric Power Co. was established in 1972 after Okinawa was returned to Japan from the United States [Federation of Electric Power Co. of Japan, 1993, p.344-p.346]. There

are ten Japanese electric utility companies as of March 1995. These electric utilities are regulated by the Ministry of International Trade and Industry (MITI) under the "Electric Utilities Industry Law", enacted in 1964. This law regulates the business operations of utilities and also keeps the utilities as regional monopolies [Denryoku Shinpou Sha, 1987, p.178]. The objectives of regulation in the telecommunications business, "social" and "economic", as discussed in chapter 2, can be applied to the electric utility business as well. The law also regulates utilities in businesses other than their core business, and when an electric utility wants to conduct side business such as telecommunications services, it usually must get permission to establish a subsidiary, and have the subsidiary conduct the business.[1]

This regional monopoly system in Japanese electric utilities will end in 1995. Currently, the modification of Electric Utility Business Law is under discussion as one of the deregulation processes of industries in Japan, accompanied with a fundamental reformation of rate systems. The modified law will liberalize the wholesale business of electricity, deregulate the permission system of DSM programs, and allow new entrants into the retail market for electricity under some limited conditions [Denki Shinbun, 1995a]. Following deregulation of the telecommunications market, competition will be soon introduced into the Japanese utilities market.

Current Managerial Issues for TEPCO

Despite deceleration of growth in total electricity sales (1.1 %, 1992 - 93), in 1993, summer peak loads registered a record high of 54,100 MW [TEPCO, 1993]. The demand and supply of electricity are forecasted to continue to be tight in the future. Competition in the electricity market will begin in 1995. Under these conditions, TEPCO must provide customers with a stable supply of electricity with low cost and high quality. To achieve this, TEPCO must address several issues, such as locating new power plants, conducting efficient demand-side management, and also protecting natural resources and the environment.

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[1] In fact, the law does not prohibit side business itself. Article 12 of the Electric Utilities Industry Law requires utilities to obtain permission from the Minister of International Trade and Industry, and also prohibit the minister from granting permission unless he can see that doing the side business will not interfere with the core business. [Agency of Natural Resources and Energy, 1987]

3.2 Why Fiber Optics for TEPCO?

Telecommunications technology has played an important role as infrastructure in utility service since its early stages. To maintain the balance of demand and supply of electricity, which changes every moment, it is critical to control rapidly and precisely whole power systems, such as power plants, transformer substations, and distribution stations, which are distributed nationwide. In addition, when an accident occurs, it is necessary to gather accurate information from each plant and station rapidly, in order to recover promptly. These daily operations of utilities require robust telecommunication networks with high quality. In general, TEPCO has installed telecommunications networks for four main purposes: to stabilize power systems, to monitor and control power facilities, to help communication for maintenance of facilities, and to provide internal information systems for daily operation and management.

Telecommunications technologies currently used in TEPCO include wireless technology with several bands, and wired technology including optical fiber cable, power line carrier, and metal cable [TEPCO, 1992]. Among these, power line carrier technology, in which data is carried via power lines, is the oldest type, and TEPCO has used it since its foundation in 1951. This system provided a convenient communications method for an electric utility, but the efficiency of data transmission decreased as power lines branched and became complicated. Then, microwave wireless technology, introduced in 1955, gradually replaced power-line carrier technology. Microwave technology includes 2 GHz, 7 GHz, and 12 GHz ground wireless systems and 20 GHz and 30 GHz satellite wireless systems. Because of its high stability and low cost, microwave telecommunication systems have effectively penetrated TEPCO.

On the other hand, because of increasing requirements for high capacity data transmission with digital technology, optical fiber technology was focused on. After about two years research, TEPCO's first optical fiber network was installed in 1978. The unique features of optical fiber are that it can transfer information without interference from electromagnetic waves from power lines, and that it can transfer larger quantities of

information without the intermediate relay than other methods.[2] Electric utility companies developed an Optical Ground Wire (OPGW) in 1984, a lightning arrester cable on the top of steel towers that includes an optical fiber cable in its core, and this technology is now beginning to dominate the utility's fiber networks as the most appropriate telecommunications technology for an electric utility.[3] At present, TEPCO uses optical fiber networks for 1.5 Mbps, 6 Mbps, 32 Mbps, 100 Mbps, and 400 Mbps of digital data transmission, depending on the requirements of applications.

3.3 Initial Strategies of TEPCO and the Results

3.3.1 Purpose of Entrance

TEPCO officially explained that the initial purpose of entering the telecommunications business was mainly to provide other telecommunications service providers with TEPCO's facilities (such as steel pylons, electric poles, and underground conduits), which could be used as infrastructure for a NCC's construction of large-scale and reliable telecommunication networks [Tsukiyama, 1995]. At the time of telecommunications deregulation in 1985, TEPCO expected to be able to co-operate with an NCC if only one NCC entered the market. However, three NCCs finally entered the market, and each of them asked TEPCO to provide its facilities (electric poles and underground conduits) within the same area. Furthermore, prospective urban-type CATV companies also wanted to use these facilities. Many difficulties could be expected if TEPCO let all telecommunications service providers use their facilities. Ultimately to fulfill all these requirements, TEPCO decided to establish a Type I telecommunications subsidiary, and lease its optical fiber cables itself to these NCCs and CATV operators through the subsidiary, instead of leasing electric poles and underground conduits.

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2 In the case of Single Mode Optical Fiber Cable (SM-Type), which is mostly used in TEPCO, 100 Mbps data can be transmitted in 48 Km without relay. Detail results of research in optical fiber cable for electric utility use is described in [SECR, 1993].

3 The length of OPGW laid by electric utilities in Japan was 12,538 km as of March, 1991, which was 43.6 % of 28,748 km utility fiber networks, whereas overhung fiber cable comprised 41.7 % and underground fiber cable 14.7 %.

This brief history describes that the initial purpose for TEPCO to enter the new market was not to utilize the spare capacity of optical fiber networks for the external revenue and compete aggressively with NTT, but just to coordinate the telecommunications industry and ease the business operations of TEPCO. Such a not-so-positive attitude toward the new business might look like camouflage of the real objective in order to persuade both government units, MITI and MPT, which regulate utilities' entry into the telecommunications business. It could appear that if all utilities in Japan entered the telecommunications market and connected their networks with each other, composing a nationwide telecommunication networks as large as NTT, it would have a strong impact on the initial entries of NCCs. In such a case, NCCs would have complained about it and both regulators would have disallowed the utilities' entries. It can, therefore, be surmised that the reason TEPCO insists that they were forced to enter the telecommunications business was in fact to avoid the worst case scenario in which they are allowed to conduct no telecommunications services.

3.3.2 Overview of TTNet

After all these machinations, TEPCO established a telecommunication subsidiary, the Tokyo Telecommunication Network Co. (TTNet), with two Japanese trading companies, Mitsubishi Corp. and Mitsui & Co., in March 1986. TTNet obtained a permission for the Type I business in August 1986, started a private leased circuits business in November of the same year, and began offering telephone service in May 1988.

As of April 1993, TTNet provides two kinds of service: private leased circuit service and telephone service. The service area of TTNet is equal to that of TEPCO, which comprises 459 cities and communities in the Tokyo metropolitan area. The total line extension reaches 20,100 km, in which the length of relay lines is 6,900 km and that of subscribers' lines is 13,200 km [TTNet, 1994b].

The FY 1993 revenue of TTNet was 43.6 billion yen ($436 million), an increase over the previous year of 13.0%. Fifty-two percent of the revenue comes from leased circuits, 3.6% from telephone service, and 43.8% from businesses other than telecommunications service [TTNet, 1994d], which include maintenance of TEPCO's

telecommunications networks and contracts with other NCCs to provide TTNet's network for their telecommunications services.[4] Annual income has been in the black since 1991, but the annual income from telecommunications service, 5.1 billion yen ($516 million), is less than the annual income from the business other than telecommunications service, $8.8 billion yen ($880 million).

3.3.3 Strategy for Network Construction

TTNet has the advantage of access to TEPCO's telecommunications technology and accumulated know-how. TTNet acquired the right to use a part of TEPCO's telecommunications networks, such as OPGW. It has expanded relay and subscriber networks using TEPCO's facilities (such as electric towers, electric poles, and underground tubes), and has constructed networks with TEPCO where the needs of both companies match. Through these activities, both TTNet and TEPCO conserve money by sharing construction costs, and TTNet is able to expand its networks efficiently.

Figure 3.3.3-1 shows a simple image of the architecture of TTNet's telecommunication network. It is composed of eleven switching stations, many transmission terminals, relay transmissions lines and subscribers lines. One switching station exists in each of eight suburb prefectures, and three switching stations in the Tokyo area, while many transmission terminals are distributed in each prefecture. Data and voice from customers go directly to the related transmission terminal through a subscriber's line. These transmissions are gathered in a switching station through relay transmission lines and are sent to another switching station, also via relay transmission lines. They are then sent to the recipient through the related transmission terminal. Branches to other telecommunications providers (e.g. NTT and DDI) emanate from switching stations. A subscriber's line uses optical fiber or copper cable, while a relay line usually uses optical fiber cable and Optical Ground Wire (OPGW), a lightning arrester cable on the top of steel towers that includes an optical fiber cable in its core. The switching stations and transmission terminals are connected by dual or triple looping routes to improve reliability of the network.

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[4] Under the current regulation, "telecommunication service" means a service to end users, and providing networks to other Type I carriers is regarded as a business other than telecommunications business.

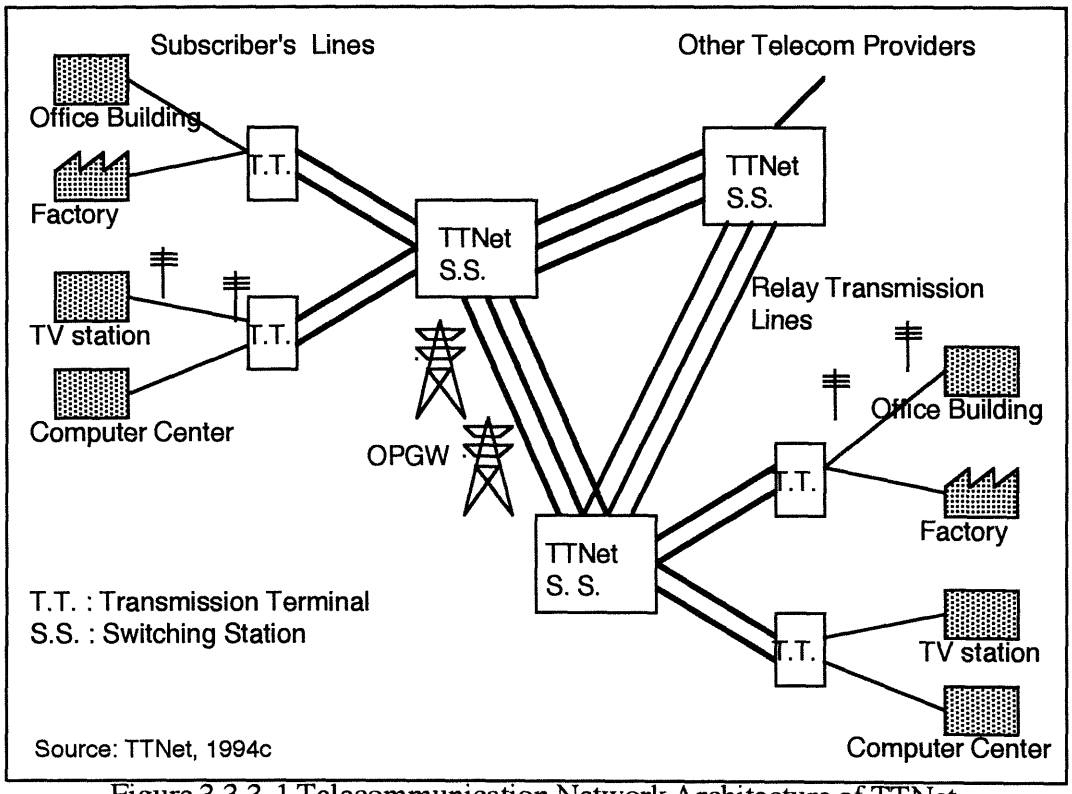


Figure 3.3.3-1 Telecommunication Network Architecture of TTNet

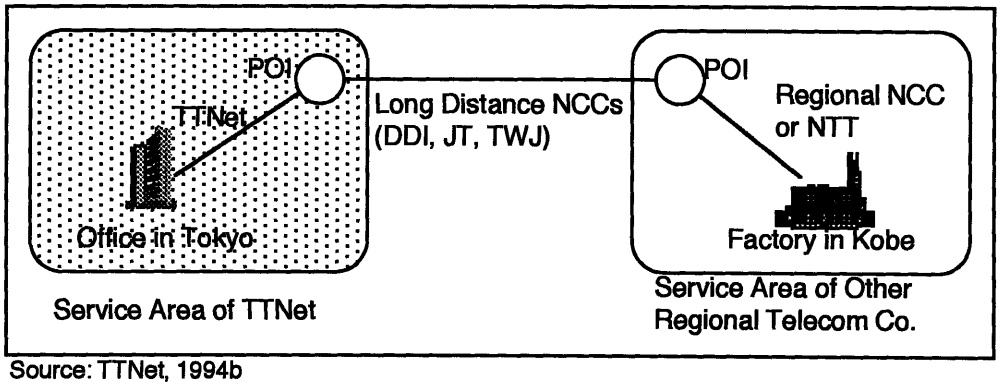
3.3.4 Strategy for Private Leased Circuits Services

Customer Target and Market Structure

Because of their well expanded optical fiber networks, the major targets are corporate customers who need high-speed in-house communication lines that start and end within the Tokyo metropolitan area, the service area of TTNet. They have also been pursuing the realization of connections with other NCCs to attract customers who have communication partners outside the TTNet service area. The ideal situation is to connect all regional utility-affiliated NCCs directly, which would become the "second NTT" in scale. Currently, connections with long distance NCCs and international carriers have been completed with regard to high-speed digital transmission service.[5] Indirect

[5] Connections with long distance NCCs (DDI, JT, and TWJ), and connections with regional utility-affiliated NCCs (such as OMP and CTC) through these long distance NCCs have been extant since

connection with regional NCCs has also been realized through long distance NCCs. Figure 3.3.4-1 shows the network structure of this service. In this case, an office in Tokyo can communicate with a factory in Kobe through a long distance NCC (such as DDI, JT or TWJ) and a regional telecommunications company (such as NTT or OTP). As a result, the service area and the target customers can virtually be extended beyond the Tokyo metropolitan area.



Source: TTNet, 1994b

Figure 3.3.4-1 Connection of TTNet's Leased Circuits with other Carriers

Service Menu

TTNet provides five kinds of leased circuit services: high speed digital transmission services (64kbps ~ 6Mbps), analog transmission services (3.4kHz and voice transmission), general digital transmission services (2,400bps, 4,800bps, 9,600bps), analog image transmission services (Hi-vision, general image and voice for TV), and digital image transmission services (100Mbps and 150Mbps). Their services have more diversified options with less cost compared with NTT. One feature is their emphasis on high-speed digital service to optimize the capacity of optical fiber cable. They have also, since 1987, been aggressively promoting their image transmission services such as analog Hi-Vision and digital television transmissions to broadcasting companies and CATV operators.

1987. Furthermore, since 1988, circuits of TTNet has been used as a domestic circuit for international leased circuits provided by international carriers such as Kokusai Denshin Denwa Co. (KDD), International Telecom Japan (ITJ), and International Digital Communications (IDC).

Rate System

Because TTNet can share the construction cost of networks with TEPCO, their service rates are 10% ~ 20% lower than those of NTT in all service menus if the service is completed within the service area of TTNet. When a customer constructs private networks beyond the metropolitan area by using leased circuits of TTNet, a long distance NCC, and a regional NCC, the cost is the sum of each NCC's rate in each area, since the end-to-end rate system has not been used. Because the number of POIs -- which are connection points between two carriers -- is very limited,[6] the total cost in this case might rise or fall compared with the case in which the circuits are leased only from NTT, depending on the distance between POIs and customers.

Results

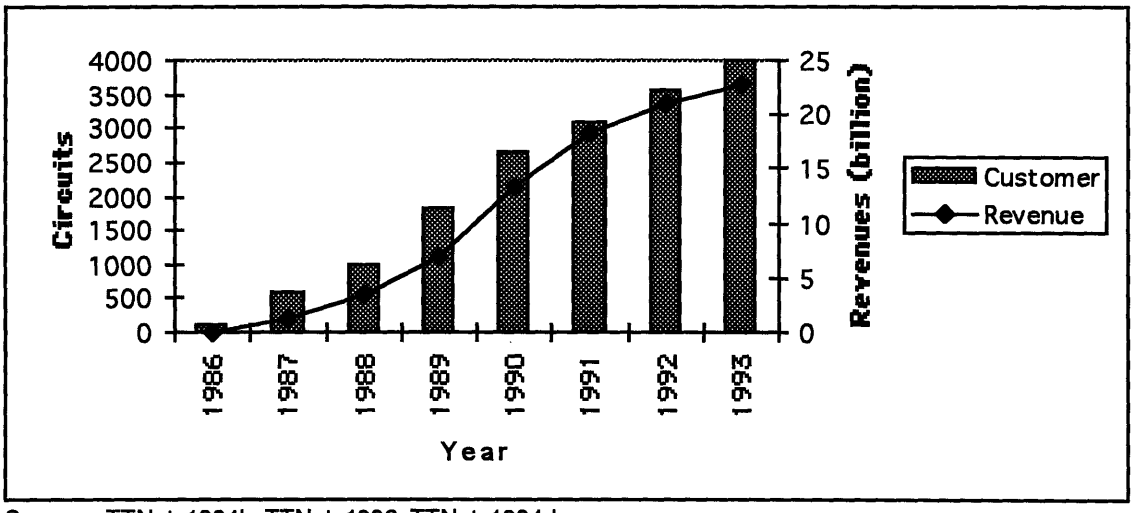
Because both the number of leased circuits and the revenue for the service are growing faster than is the total market, and also because the market share of TTNet for the leased circuit service is growing continuously, it can be said that the private leased circuits service is not only surviving the competition but also will continue to grow.

The growth in the number of leased circuits and the revenues of TTNet are shown in Figure 3.3.4-2. The annual growth rate of the number of leased circuits was 15.40% for FY 1992, that is, greater than the growth rate of the total number of leased circuits, 4.4%. The annual market growth rate of TTNet is 9.31%, which is also greater than the total market growth rate 6.8%; and the market share of TTNet is 4.04%, which is steadily growing (as shown in Figure 3.3.4-3). TTNet announced that it had obtained a stable share of 37% ~ 38% in the total number of circuits for high-speed digital transmission service within the Tokyo metropolitan area for FY 1991, 1992, and 1993.

TTNet can currently compete with NTT in technological reliability, service menu, price, and to a limited degree in service area. TTNet also emphasizes its feature of high capacity networks suitable for image transmission, which has attracted broadcasting firms

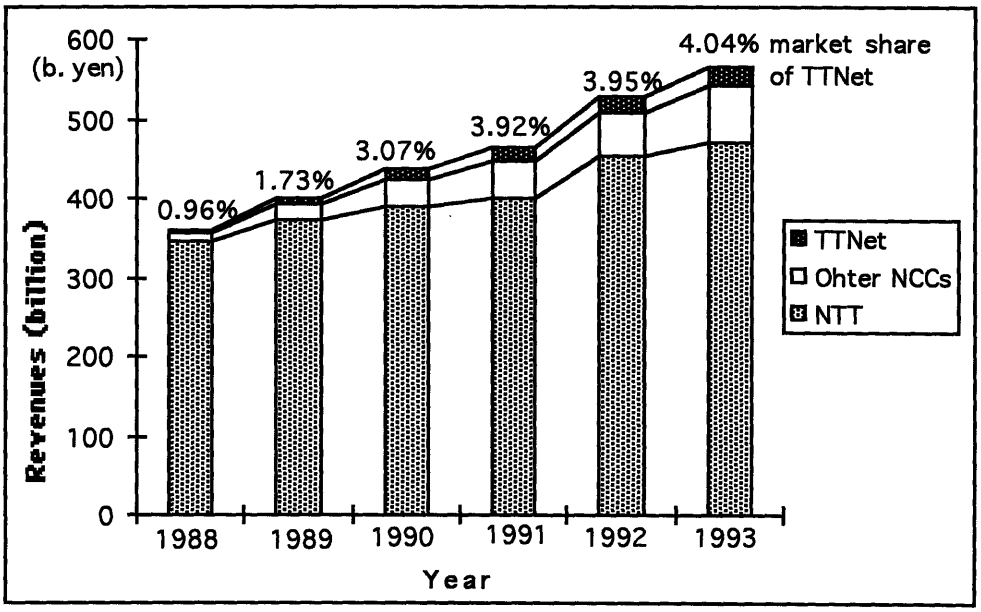
6 TTNet has only two POIs for each long distance NCC. See [TTNet, 1994a].

who want to improve their network infrastructure for the use of high technology. As a result, TTNet has taken a good start in its private leased circuits services.



Sources: TTNet, 1994b, TTNet, 1992, TTNet, 1994d.

Figure 3.3.4-2 Customers and Revenues of Leased Circuits Service of TTNet



Sources: TTNet, 1994b, InfoCom Research, 1994a.

Figure 3.3.4-3 Market Growth of Leased Circuits Service

3.3.5 Strategy for the Regional Telephone Services

Customer Target and Market Structure

Because the telephone networks of TTNet are independent from those of NTT, they emphasize that they can provide more flexible service than NTT regarding price and functions. However, this also means that they have to install whole subscriber networks. This is a costly business and NTT has managed to do it by cross-subsidization from the income of long distance calls. Because the installation cost of optical fiber networks is so expensive, TTNet has targeted corporate users as major customers and promoted group subscriptions within a building, which can reduce the installation cost per subscriber.

However, the services of TTNet currently have serious limitations.

(1) Limitation in the communication area

The area in which subscribers can communicate with each other is strictly limited to within the service area of TTNet, the Tokyo metropolitan area. In the case of leased circuit services, the connection with other long distance NCCs can expand its service area, but in the case of switched telephone service, such expansion of service area is not yet allowed. The only exception is international calls, which has been realized through the connection since January 1991 with KDD. This limitation is the result of governmental regulation.

(2) Limitation in access with other telecommunications service providers

Connection with NTT has been realized since April 1991. However, this access is only a one-way access in which a subscribers of TTNet can call a subscribers of NTT but not vice-versa. TTNet has been negotiating with NTT about two-way connections, but the agreement has not been reached because of the problem of cost.[7] This limitation is an issue between companies. The

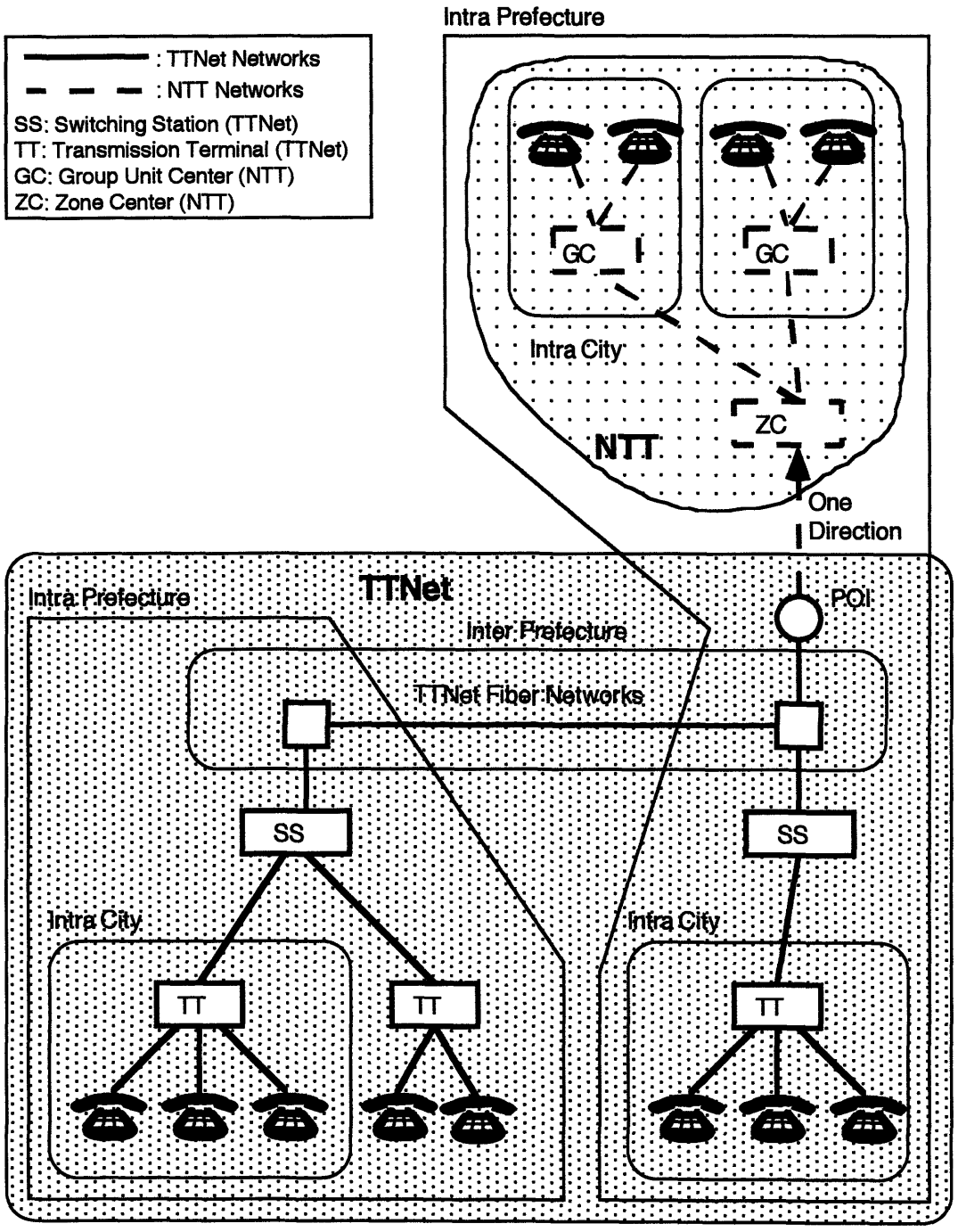
---

7 The major remaining problem is the cost of connection. Under the current system, the calling cost beyond the TTNet networks is the sum of the cost for TTNet route and the cost for the NTT route. In the case of a call from a customer of TTNet to a customer of NTT, the calling rate can be lower than the rate of NTT because the networks of TTNet can be used. However, in the opposite case,

governmental restriction of service area applies even in the case of accessing NTT, where a customer of TTNet cannot call NTT customers beyond the Tokyo metropolitan area.

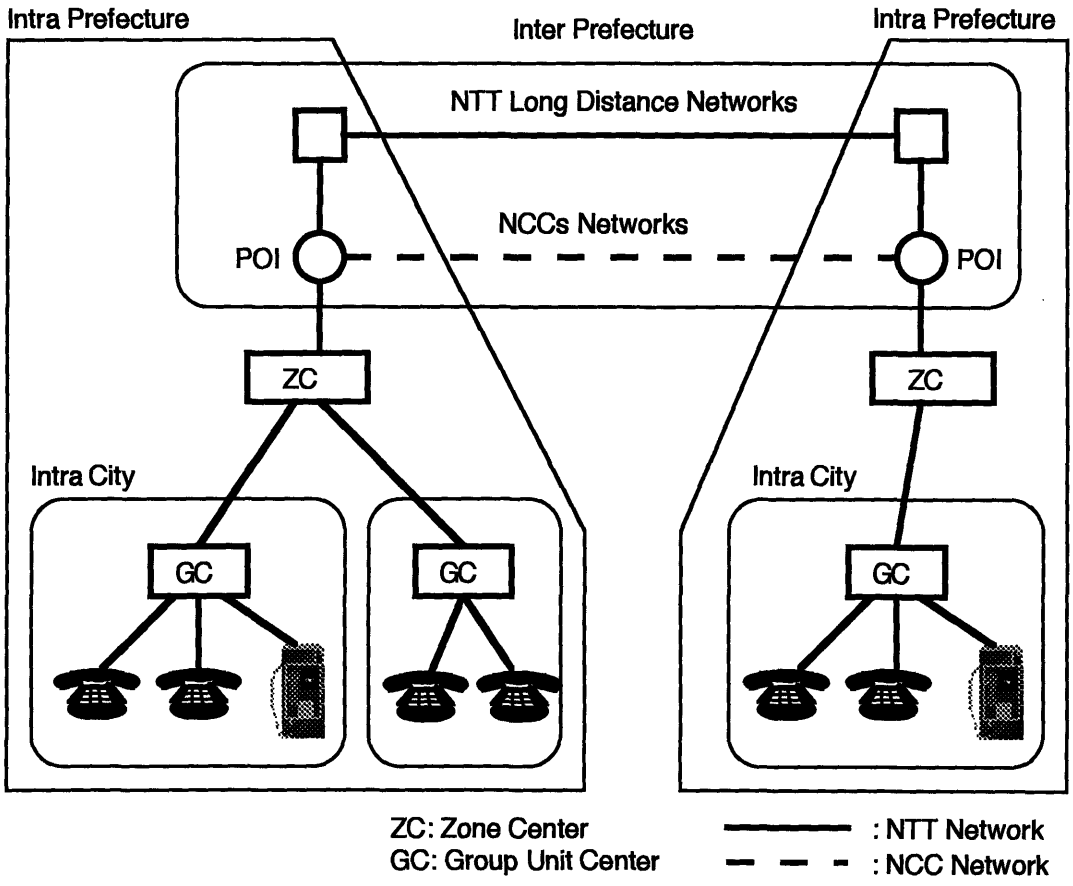
Figure 3.3.5-1 shows the network structure of the telephone service of TTNet. For comparison, the telephone network structure of NTT and other long distance NCCs is shown in Figure 3.3.5-2. A concrete definition of "regional telephone service" does not exist, but it can be said that the telephone service of TTNet includes both intra-city calls and inter-city calls, or long distance calls with area limitations. As a result, TTNet can bypass the NTT's subscriber networks by itself. Because of the limitations described above, however, customer targets are narrowed mostly to corporate customers who have several offices within the Tokyo metropolitan area and make frequent calls among these offices.

NTT insists on using NTT route as much as possible, which increases the cost of connection and raises the calling rate to more than the original rate of NTT. Whereas TTNet was able to bear the additional cost, they did not do so fearing the increasing deficits.



Sources: TTNet, 1994c, InfoCom Research, 1994b, Suzumura and Nanbu, 1993.

Figure 3.3.5-1 Network Structure of TTNet and NTT Telephone Service



Sources: InfoCom Research, 1994b, Suzumura and Nanbu, 1993

Figure 3.3.5-2 Network Structure of NTT and Long Distance NCCs Telephone Service

Rate System

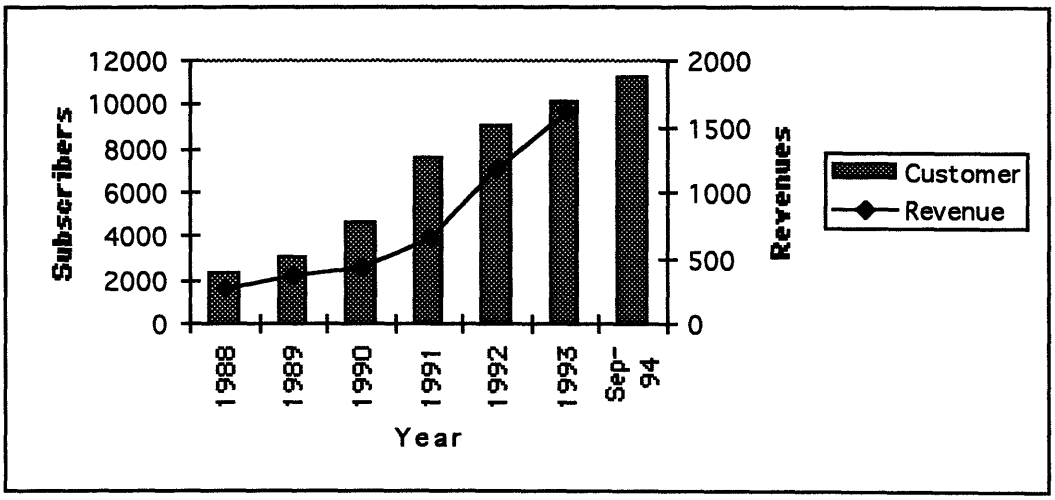
Even compared with the most discounted rate of NTT and all other long distance NCCs, the calling service rates of TTNet are lower, or in the case of the metered rate system, they are the same.[8] TTNet introduced the first fixed rate system in Japan in March 1994, to compete with NTT. In this system, a customer can make both local and long distance calls within the Tokyo metropolitan area at any time for 26,000 yen ($260)

8 The only exception is the intra city calling rate using the access to NTT.

per month, if the total calling time is less than 40 hours. Through these diversified pricing strategies, TTNet has tried aggressively to expand its subscribers. In other words, it is inevitable for TTNet to attract customers by lowered and diversified prices, because the services of TTNet are much more limited than those of NTT regardless of the high quality.

Results

Revenues and changes in the number of subscribers of TTNet telephone service are shown in Figure 3.3.5-3. The growth rate of the revenues is superior to that of the subscribers, which means that TTNet is expanding its market effectively, and that is the good news. The bad news is that both numbers are too small to offer significant competition with NTT.



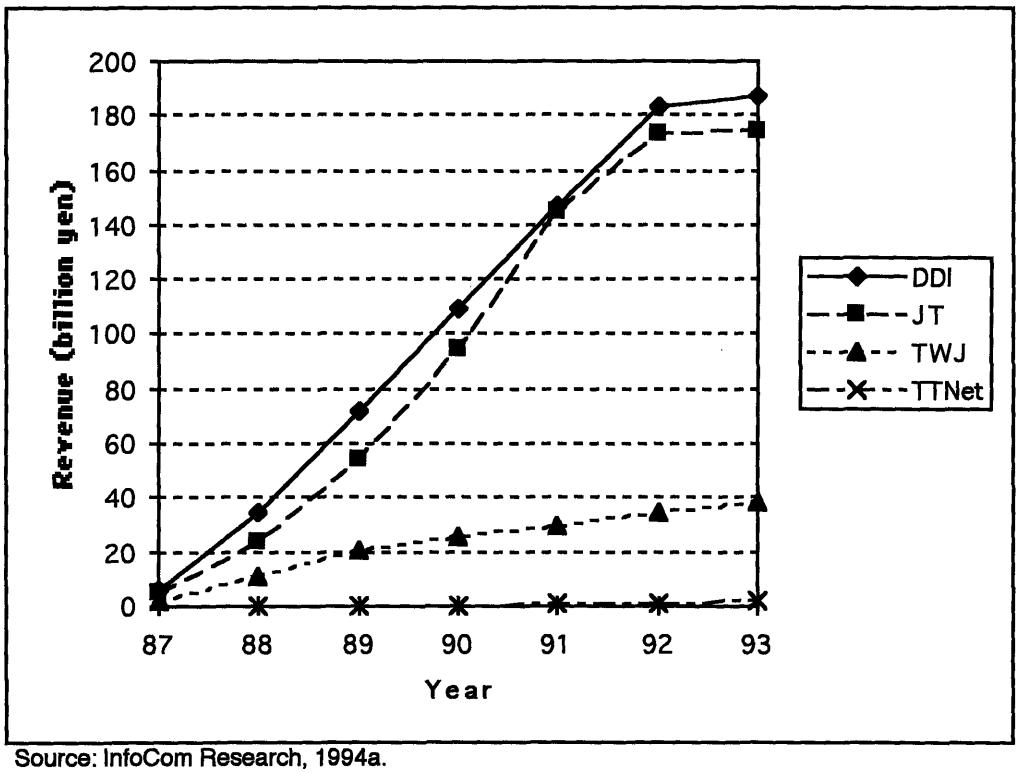
Sources: TTNet, 1994b, TTNet, 1992, Tsukiyama, 1995.

Figure 3.3.5-3 Changes in Subscribers and Revenues of TTNet Telephone Service

As mentioned in chapter 2, the estimated share of customers of TTNet in the Tokyo metropolitan area is about 0.05 %. The expansion of a system that requires interoperability generally has a critical mass point. It is difficult to expand users of the system automatically if the number of users is less than the critical mass point, but once the number exceeds the critical mass, it will expand dynamically. According to a research

by Masaru Miyajima, a Professor in Tokyo Institute of Technology, the critical mass in a telecommunications system is 10% of total potential customers [Miyajima, 1993, p.117 - p.155]. Compared with this figure, the subscribers of TTNet fall far below the critical mass, which forces TTNet to struggle for expansion of its customers.

With regard to the market share, there is no comparable data of potential market size for TTNet because there is no market segmentation for its strictly limited service area. Figure 3.3.5-4 shows the change of the market of telephone services by all NCCs [InfoCom Research, 1994a, p.32]. The telephone service revenue of NTT is 4.9 trillion for FY 1993, making TTNet's market share only 0.03 %. It might not be appropriate to compare the market share with that of NTT because of the strict limitation of the communication area of TTNet, but the market share would still be small even if the area were factored. After all, it can be seen that TTNet has not yet exceeded the critical mass point despite its attractive pricing strategies, and therefore the market share is still too small.



Source: InfoCom Research, 1994a.

Figure 3.3.5-4 Changes in the Telephone Service Market

3.3.6 Other Telecommunications Business by TEPCO

TEPCO has invested in wireless telecommunications services, such as pagers and cellular, which are growing rapidly as discussed in chapter 2 (the annual market growth rate of pagers service in 1993 is 24.2%, and that of cellular service is 35.1%). With regard to pagers service, TEPCO owns Tokyo Telemessage Inc. (TTM), jointly with JT and Mitsui and Co.; this company started the pager service in October, 1987. The market share of TTM is 43% for FY 1993, and subscribers reached one million in July 1994. With regard to cellular service, TEPCO owns 10% of Nippon Idou Tsushin Corp. (IDO) with Toyota and TWJ, which began cellular service in December 1988. The current market share of IDO is 27%, and subscribers reached 400 thousand in September 1994. Both services use the leased circuits of TTNet to connect the base stations with switching stations. TEPCO's investments in these wireless communication services can be seen to have succeeded thus far, and to have spurred the growth of TTNet.

TEPCO and TTNet are also conducting two projects towards future telecommunications services: the personal handy-phone system (PHS), which is known as personal communication service (PCS) in the United States, and an experimental project of CATV-telephone service. Both projects focus on private or residential users, and TEPCO and TTNet expects this customer segmentation to make up for the current customers of TTNet, most of which are corporate customers.

PHS service in Japan will go nationwide in the fall of 1995. To provide PHS service in the Tokyo metropolitan area, TTNet and TEPCO has established a subsidiary, Astel Tokyo Corp., with Mitsubishi Corp., Mitsui & CO., JT, and others including foreign firms. Because PHS uses micro cell technology which requires extensively expanded networks to connect each base stations, it will be a good opportunity to speed up the deployment of TTNet's regional networks. However, as mentioned in chapter 2, Astel Tokyo will initiate the service using NTT's networks despite the initial aim of using TTNet's independent networks. They explain that the networks of TTNet are still not so well expanded as the networks of NTT, which will be a severe disadvantage compared with other prospective PHS service providers who will use NTT's networks. They also

says they will use TTNet's networks in the future when they are expanded enough to compete with NTT's networks, but the time frame is uncertain.[9] Therefore, TTNet and TEPCO currently see the business opportunity of PHS just as a capital investment with uncertain benefits.

The second project of TEPCO and TTNet is a study group to consider the future multimedia business. TEPCO, Mitsubishi Corp., Mitsui & Co., and Tokyu Corp. established this group jointly in March 1994, and called it "the New Generation Network Study Group". The first three companies are major owners of TTNet, and the last is a railway corporation who owns a CATV company, Tokyu Cable Television. Thanks to the government's deregulation of the CATV business, in which CATV operators will be able to enter into telecommunications services, Tokyu Corp. seeks to confirm the business opportunity in telecommunications, while others want to expand the telecommunications services of TTNet into the residential market and boost TTNet's revenues. This group was formed to study future multimedia businesses such as video-on-demand service and CATV-telephone services with the hybrid system linking coaxial cables for CATV and optical fiber networks of TTNet [Nihon Keizai Shinbun, 1994].

The group is currently conducting experimental trials of PHS using CATV networks to connect the distributed base stations of PHS, targeted for completion in March 1995. The purpose of this experiment is to judge the technological feasibility and user preferences of PHS service on CATV networks [Nikkan Kougyou Shinbun, 1994]. The group will also start a series of trials of telephone service using CATV facilities in conjunction with seven regional cable TV operators in the Tokyo metropolitan area for about one year, beginning in March 1995 [New Generation Network Study Group, 1994]. It will provide CATV-telephone terminals to about fifty subscribers of each CATV operator, connect the seven CATV-telephone networks with TTNet's telephone networks, and offer telephone service to the CATV subscribers and also to TTNet subscribers. Monitors can also call NTT subscribers in the Tokyo metropolitan area because this experiment uses TTNet telephone networks, but they cannot receive phone calls from NTT subscribers.

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[9] Based on a personal interview by the author with Ichiro Yagisawa, Assistant to Manager, Electronic Telecommunications Department, TEPCO.

Does this movement really support the struggling telephone business of TTNet to ride on the right rail? Even if the regulation hurdle for CATV-telephone is removed, the communication area limitation and access limitation of TTNet will remain. As we have seen in chapter 2, urban-type CATV's penetration among Japanese households is currently only 4%. Given that this percentage can be applied in the service area of TTNet, the percentage of TTNet telephone subscribers would be still below the critical mass point of 10% even if all CATV operators started telephone service with TTNet. It is true that TTNet can expect a synergy effect of expanding its telephone service subscribers because the CATV industry is expected to grow; and MPT also expects the market penetration of urban-type CATV subscribers to reach 60% by 2010, but TTNet cannot be thus optimistic. There is also a high possibility in which CATV operators make alliances with NTT and begin telephone service after the experiments with TTNet because of NTT's well-organized telephone networks. In fact, the same case occurs with the PHS strategy of Astel Group. Therefore, these future telecommunications projects might be one of several successful strategies for TTNet, but TTNet must provide strong incentives to its partners.

3.4 Cases of US Utilities

In addition to Japan, there are several countries in the world where electric utilities have entered or are entering the telecommunications market. These include Britain, Germany, United States, and Holland [The Economist, 1995]. Utilities in these countries have been expanding their internal optical fiber networks, and their potential for offering telecommunications services are high. Given that local competition is necessary for the prompt construction of the NII at reasonable cost, the telecommunication networks of utilities are clearly one solution for the realization of the NII. From this viewpoint, Al Gore, the Vice President of the United States, mentioned in a speech[10] that Clinton's administration would support removal of legislative restrictions on all types of telecommunications companies, which include cable companies, telephone companies, utilities, televisions and satellite, seeing utilities as a player in the future NII. Encouraged

[10] Remarks by Vice President Al Gore at the National Press Club, December 21, 1993.

by such a supportive atmosphere, many utilities in the United States are beginning pilot projects relating to telecommunications, although the regulation issue is still uncertain.

3.4.1 Pilot Telecommunications Projects

There are currently more than two dozens ongoing telecommunications projects being conducted by utilities in the United States (see Table 3.4.1-1). These trials can be categorized into three types, depending on the objective of the project:

(1) making excess capacity of their internal backbone fiber networks available for lease by outside telecommunications service providers. This is the simplest kind of telecommunications service offered by utilities.

(2) offering telecommunications applications to residential customers exclusively for the utility's internal purpose. An example is to offer an automated meter-reading service (AMR) using a wireless telecommunications network.

(3) installing cable to customer premises, to provide not only utility service such as advanced demand-side management (DSM), but to also provide more general telecommunications services, such as bypass service to local exchange carriers as competitive access providers (CAPs) do, CATV service, and home automation. Some utilities conduct these services with other partners, such as telecommunications service providers, CATV operators, and entertainment companies.

Table 3.4.1-1 Telecommunications Pilot Projects by US Utilities

Electric Utility	States	Prj. Size *1		Comments
American Electric Power	OH	25,000	* 2	DSM by existing telephone lines
Baltimore Gas & Electric Co	MD	-		Lease excess capacity
Central & South West Corp	TX	2,500		DSM by two-way communication
Entergy Corp	AR, LA	1,500		DSM by two-way communication
Glasgow Electric Plant Board	KY	2,000		CATV, Long distance access
Kansas City Power and Light	KS	420,000	* 3	AMR with wireless networks
Pacific Gas & Electric	CA	2,000		DSM by two-way CATV cables
Public Service Electric and Gas	NJ	10,000	* 4	DSM with AT&T, Honeywell, etc.
Southern Company	GA	50		Trials of Real Time Pricing
Hydro Quebec	Canada	600		DSM with CATV, Bank, etc

*1: The size of the project. The number indicates the number of involved homes or offices.
*2: Projected size in 1995. AEP will install 100,000 systems over the next three years.
*3: Projected size by 1996
*4: Projected size by 1996
Sources: Sessions at DA/DSM 95, Interviews by the author, Dunklin and Causey, 1995, Cavanaugh, 1994, Hansen, 1995

Baltimore Gas and Electric Co. (BG&E) is an example of type (1). BG&E has installed 236 miles of optical fiber cable for their internal communications since 1986, and since 1991 it has leased the cables to others including a major long distance carrier [Kripalani, 1994]. Houston Lighting & Power Co. and Scana Corp. are also in the type (1) category. These companies are only leasing cables at present, but there is a high probability that they will pursue opportunities to offer additional telecommunications services and enter the type (2) or (3) category.[11]

Kansas City Power and Light (KCPL) belongs to the type (2) category. KCPL is expanding their project of automatic meter reading (AMR), not as a pilot project but as an actual service, which will be completed by 1996. The project is based on a wireless technology called CellNet, because wireless technology was judged to be the most cost-effective. They say the wired solutions, such as optical fiber networks and hybrid networks of fiber and coaxial cables, are still too expensive to expand thoroughly to residential customers. Based on its successful early experience, KCPL is now thinking

[11] George Dieter, BG&E's supervisor of telecommunications planning, showed their interest in forming a partnership with cable companies and even the local telephone companies and conducting telecommunication services. See [Dresser, 1994].

of offering additional utility services to customers, including DSM and selectable billing dates.[12]

Projects in the category (3) are expected to yield high profits, but also may entail risk because of future uncertainties. Several aggressive utilities have started this type of project. In the fall of 1994, Pacific Gas and Electric Co. (PG&E) started a pilot project of energy information systems by organizing a consortium with TCI, a major CATV company, and Microsoft Corp., a software giant. They distributed small control systems based on Microsoft's Windows software, which could control continuous two-way communication between utilities and residential customers and provide energy information through cable television networks. The initial objective of this project is to provide advanced DSM to residential customers, but the company is thinking about providing general telecommunications services in the future. The system will be installed in 2,000 homes in Walnut Creek, California, with an average cost of about $1,000 a home [Salpukas, 1994]. PG&E expects that the cost might drop to $200 as the project is expanded.

Entergy Corp. is also conducting a residential energy-management trial project that offers time-of-use pricing-based DSM as the economic driver for a two-way hybrid (fiber/coax) telecommunication system. The project was started in fifty residences in Arkansas and has been expanded to 2,500 residences in Louisiana. The system, called PowerView, was developed by First Pacific Networks, Sunnyvale, California. It can enable customers to automatically shift electricity consumption (such as air-conditioning and heating) away from peak-demand periods by user programming. Other potential applications include load research, remote meter reading, automated billing, outage notification, and remote connect/disconnect. In addition to these energy management services, this system can offer bypass service to long-distance service providers and cable television service. They expect the saving from the result of these DSM systems to be more than the total cost of installing the PowerView telecommunications infrastructures. Furthermore, because only 5% of the system's total capacity is used for the DSM and

[12] In a session in DA/DSM '95 in San Jose on January 23, 1995, Doug Morgan, the Vice President of KCPL, said that they would implement advanced telecommunication services with two-way communication system in phase three of the project in 1996.

other utility operations, 95% of their telecommunications infrastructure will be remaining as dark fiber, which they want to sell to other service providers (such as security, home shopping, telephone service, and entertainment) [Cavanaugh, 1994].

An interesting case study was conducted by the Glasgow Electric Plant Board, a municipal electric utility in rural Glasgow, Kentucky (population 13,000). Since 1989, it has offered its customers CATV service and a means to connect with the information banks at schools and libraries. Since they entered the CATV market, the previous monopoly cable operator in Glasgow, owned by Scripps Howard, has lost about 30% of its subscriber base [Kripalani, 1994]. The municipal utility is hoping to provide a telephone service competitive with GTE, the regional telephone company.

3.4.2 Driving Factors

There can be said to be four major driving factors for these telecommunications projects by utilities in the United States: (1) technological feasibility with optical fiber networks, (2) threat of further competition in the electric utility business, (3) the necessity for further DSM, and (4) additional revenues. The first and the fourth are common with the Japanese case, while the second and the third are characteristic of the United States. An analysis of these four factors driving electric utilities to enter the telecommunications market is given below.

Technological Feasibility with Optical Fiber Networks

As well as Japanese utilities, several utilities in the United States have installed significant lengths of optical fiber network for their internal telecommunications requirements. Table 3.4.2-1 shows the length of optical fiber cables installed by some utilities in the United States. A utility can economically expand its fiber network using their own facilities and the previously explained OPGW technology. They also have many skillful engineers and the know-how to expand optical fiber networks. Such technological advantages give a utility the opportunity to enter the telecommunications business.

Table 3.4.2-1 Length of Optical Fiber Cable by US Utilities

Company	Miles installed	Year installed	Installment cost ($mil)	Additional miles planned
Scana Corp.	1,800	1985	$75	3,300
Southern Co.	1,600	1986	$90	600
Entergy Corp.	700	1989	$30	700
SCEcorp	650	1982	$16	850
American Electric Power	350	1984	$16	500
Duke Power	340	1984	$12	60
General Public Utilities	330	1991	$20	110
Baltimore Gas & Electric	230	1986	$6	50
Houston Industries	220	1987	$9	NA
Public Service Co. of Colorado	150	1985	$6	450
Total Miles	6,370		$280	6,620

Source: Kripalani, 1994

Threat of Further Competition in the Utility Business

The electric power industry in the United States is facing a trend toward competition and deregulation that began when the Energy Policy Act of 1992 deregulated the open generation market. Furthermore, some states are considering opening a retail wheeling market, which would allow the consumer to contract directly the retailer of electricity. For example, the California Public Utility Commission (PUC) proposed last April to deregulate almost totally the state's electric power industry by 2002. According to the plan, direct access would begin with large industrial customers in 1996 and reach residential customers by 2002. The decision has been postponed because of much controversy, but it will be finally made by May 1995 [Maremont, 1995]. Pacific Gas and Electric, who serves in California, is currently evaluating each power plant in its system in an attempt to compete in an open market, although hoping for the delay of full deregulation [Hansen, 1995].

Because of pressure from competition, a utility must reduce its costs to provide electricity at a price lower than that of competitors, making facility-wide information systems desirable. Utilities are also placing further importance on demand-side energy information systems and communication between consumers and utilities in order to

provide more attractive and flexible utility programs to consumers. In both cases, it is necessary for a utility to construct or to lease a robust information and telecommunications infrastructure. The telecommunications business becomes a focus of utilities.

The Necessity for Further DSM

The idea of demand-side management (DSM) was introduced after the energy shocks of the 1970's. DSM has been implemented since then to mitigate risks that come from the difficulties in forecasting the cost of production and demand of customers. At present, construction of new power plants is difficult because of high construction costs and difficulties in site location, and therefore DSM plays an important role in utility strategies.

DSM programs are diversified. In its early stage, DSM meant conservation of energy, such as replacing light bulbs with more efficient ones or selling energy-efficient refrigerators. Then, many kinds of load management technology were introduced to adjust the demand to the supply capacity, for example, peak load clipping, valley filling, and load shifting [Gellings, 1986]. Direct load control that allows utilities to regulate the customers' air conditioners is one of these DSM programs. At present, DSM involves incentive rating such as real time pricing and variable rates, which provide many options for electricity rates, allowing consumers to control their appliances, and indirectly controlling the load.

Some researchers forecast that because of the threat of competition, utilities will become reluctant to implement DSM and they will make a stronger effort to sell electricity. In fact, DSM spending by the four largest utilities in California authorized by the PUC has declined from $585 million in 1994 to $339 million in 1995.[13] However, another view by Rick Tempchin, a director of electric transportation at the Edison Electric Institute, is that competition can be good for demand-side management efforts by utilities. He said that DSM would be focused as a marketing tool to satisfy customer needs and

[13] Norman Shumay, Commissioner, California Utilities Commission, reported this in a opening session in DA/DSM™ '95, San Jose, California, on January 23, 1995. See [Hansen, 1995].

desires [Stein, 1995]. It is also true that the effectiveness of DSM is still visible. The Association of Demand-Side Management Professionals has said that DSM reduced U.S. peak load demand by 17.7 GW in 1992, which was a 5 percent reduction over 1991 and 42 percent over 1989 [Stein, 1995].

From my viewpoint, cost has generally a strong impact on the energy consumption behavior of customers, and therefore, rate-based DSM can be a good marketing tool. DSM programs require tighter communication between utilities and customers, which will also be emphasized in the competitive industry as discussed above. Thus, telecommunications become more important to utilities as the need for some types of DSM increases.

Additional Source of Revenue

Finally, it can be said that utilities are simply looking to the telecommunications business as a source of additional revenues. The 1994 telecommunications service market in the United States was $193 billion and expanding about 7.7 % in 1994 compared with a 6 % increase in 1993 [U.S. Dept. of Commerce, 1994]. The market expansion is expected to continue because of the emerging NII-related services.

At the same time, the utility market is currently maturing. The total revenue of the electric utility industry was $198 billion in 1993, almost same size as the telecommunications industry, but market growth is very low. The annual market growth was 4.5%, 1.1% and 5.1% in 1991, 1992, and 1993 respectively [U.S. Dept. of Energy, 1995, p.14]. Furthermore, the annual growth of the total sales of electricity is also very low, 1.8%, 0%, and 3.5% in 1991, 1992 and 1993 respectively [U.S. Dept. of Energy, 1995, p.14].

Because of the threat of further competition and the flat growth of electricity sales, utilities will clearly struggle to increase their revenue in the future. Diversification of business can be one strategy to survive in the matured electric power industry. Therefore, utilities want to enter the telecommunications business to increase revenue.

3.4.3 Telecommunications Applications of U.S. Utilities

The big difference between the Japanese and the United States utility industries' attitude toward the telecommunications business is the implication for a utility's core business. In the Japanese case, TEPCO conducts telecommunications services, maintaining little relationship with TEPCO's core business, electric utility. Compared to this, utilities in the United States are currently willing to enter the telecommunications business mostly by emphasizing the relationship with the core business, especially by creating customer communication systems and providing energy information service and demand-side management. It seems that U.S. utilities try to implement telecommunications service on the extended line of utility service, and they place more importance on providing applications than on providing the telecommunication networks itself.

There are ample utility applications that use telecommunications. An Electric Power Research Institute (EPRI) report divided utility applications of telecommunications into five categories [EPRI, 1994, p.6-1 ~ p.6-79]: (1) the corporate services business area, which includes internal message handling and working management; (2) the control center business area, which consists of activities that support the planning and operation of the total power system, such as monitoring and control; (3) the power plant business area, which consists of activities to construct, operate, and maintain the electric generating facilities; (4) the network business area, which includes monitoring and control of electric transmission, distribution facilities, and outage management, and (5) the customer interface business area, which has interface to the customer's premises or directly to the customer, including traditional services such as marketing, account operations, and customer site support, and emerging services such as customer meter interface and customer load management.

Telecommunications applications from type (1) to type (4) are internal applications of utilities and what utilities have traditionally implemented on their own telecommunication networks, partially because existing telecommunications did not satisfy their unique requirements and partially because it was more cost-effective to construct their own networks.

Telecommunications services of utilities that have the added potential to provide general telecommunications services related to the NII will be categorized in type (5). To install such applications, they must expand their network to reach individual customers, which is more costly than the construction of an internal network among all of the utility's facilities. A question will be whether a utility should construct its own network to reach customers or use the network provided by other telecommunications service providers. There are several alternatives to realize these applications, such as renting a network from others, building one's own network with other telecommunications providers, or building one's own network and leasing it to others.

In the previously mentioned case of the PowerView system, the telecommunications pilot project conducted by Entergy Corp., Entergy has installed its own hybrid (fiber/coax) networks to customer premises to offer demand-side management. Figure 3.4.3-1 shows the architecture of the system, which consists of three networks: the utility host network, the distribution network, and the home network [Eby, 1994]. Optical fiber cable is used in the host and distribution networks before fiber/coax nodes, and coaxial cable is used to reach to each customer. The home network consists of three main components: the intelligent utility unit (IUU), an electric meter, and an in-home user interface. The IUU is a fully-distributed switch that interfaces between the home network and distribution network and lets customers program energy use via TV sets or other small equipment.

The basic architecture is common to most utility telecommunications projects offering DSM. The installation cost of such systems is expensive. EPRI estimates the installation cost of such a telecommunication network for utility purposes only to be in the range of $450 - $600 per customer location, excluding the cost of information systems, and it will rise to the range of $900 - $1,000 per subscriber, for full service with telephone and CATV service, excluding the set-top box [EPRI, 1994, p.3-11 - p.3-13]. Entergy is expecting savings from the resulting DSM activities to more than offset the total installation cost of such a hybrid broadband telecommunication system [Cavanaugh, 1994].[14]

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[14] Entergy projected possible ultimate market penetration to 442,000 households with a peak load reduction of up to 882 MW [Vince, et al, 1994], though the time frame is uncertain. EPRI estimated

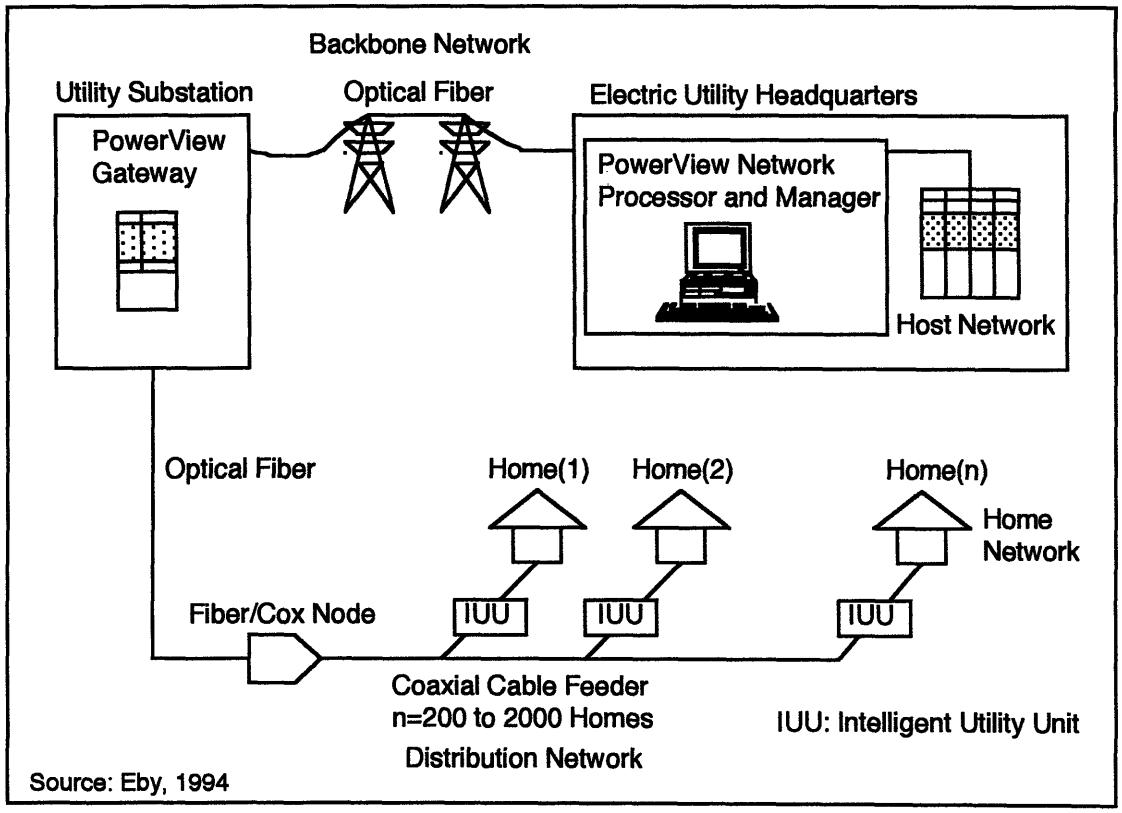

Figure 3.4.3-1 Architecture of the PowerView System

Entergy points out that it requires only 5% of the system's capacity to do all the DSM and other utility operations, and the remaining 95% of their telecommunications infrastructure will be unused "dark-fiber" [Cavanaugh, 1994]. The spare capacity can be sold to whoever needs it, for example, home security, home shopping, telephone service, and entertainment, which will be major contents in NII. It can be assumed that their true economic driver is the latter business.

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the total capital requirement of a power plant (oil/gas-fired combined-cycle power plant, 220 MW unit size) would be $490/kW in the South Central region [EPRI, 1986, p. B-24]. If I can use this 1986 data for a simple estimation, the total costs to construct a power plant for 882MW will be $432 million. If Entergy's estimation of the DSM project effect is correct, it will save the plant construction cost of $432 million, and the project will break even if the installation cost of the project is less than $998 per a customer. On the other hand, Entergy's estimation means that each customer must cut 2 kW electricity in the peak load time, which will not be easy to realize.

Many utilities who are conducting projects similar to Entergy's address advanced demand-side management programs, especially real-time pricing, as an economic driver of their broadband network installation to customer premises. Does real-time pricing for residential customers really require broadband communication with customers? The answer is no. The basic idea of spot pricing of electricity introduces the concept of market pricing in an electric utility firm. However, because it is impossible for all residential customers to participate in the bidding for electricity every moment, the idea of real-time pricing is introduced, in which rates change every certain period and the forecasted rate is informed beforehand to customers. Customers can control their use of electricity according to the forecasted rate information. Broadband technology could be useful to distribute the information of the forecasted rate to many customers at the same time, but not necessarily so. The response data (that is the data of electricity usage) will be gathered from customers monthly to make a bill, which will not require high speed telecommunication. Therefore, such a DSM program does not require a broadband network to customers.

For example, American Electric Power Co. (AEP) is conducting the same kind of energy-management project using existing telephone wires. Through a system called TranstexT, AEP sends data with low speed over the existing phone connection, which allows customers to automatically coordinate energy use. In a pilot project, AEP found that customers using the new system could cut electricity use 50 to 60 percent during peak hours [Salpukas, 1994]. Joe McDonald, the project manager of AEP, said that the existing telephone interface was perfectly adequate for their needs, and broadband connection was overkilled if the goal was a cutback in peak power consumption to minimize capital spending [Dawson, 1994].

Therefore DSM, which was emphasized as a driving factor to enter the telecommunications service, cannot be the only reason to enter the business.

3.4.4 Regulations of Utilities to Enter the Telecommunications Business

Why emphasize DSM rather than just show their will to enter the telecommunications service? Perhaps it is because of current regulatory issues.

There are three main types of electric utilities in the United States: 300 investor-owned holding companies or companies under one umbrella, 2,000 publicly owned utilities or Federal utilities, and 950 cooperative rural utilities. The number of investor-owned utilities is relatively small, but they are generally very large, vertically integrated companies who own over 75% of the nation's generation, transmission and sales of electricity [U.S. Dept. of Energy, 1995, p.1].

The investor-owned company's operation is regulated by the Public Utility Holding Company Act of 1935 (PUHCA) at the Federal level regulation. Under PUHCA, these utilities cannot diversify their business outside the core business without permission from the Securities and Exchange Commission (SEC). As with the case of the regulation by the Japanese Ministry of International Trade and Industry as discussed in previous sections, in general, SEC grants permission only if non-utility business can be seen as "reasonably necessary" or "appropriate" to the core business. Further, PUHCA currently prohibits utilities even from providing telecommunications services by separately-operated subsidiaries. From the viewpoint of protection of rate-payers, the federal government prohibits utilities cross-subsidizing between both businesses. Although Clinton's administration announced they would support utilities' entry into the telecommunications service market, there is currently no bill that supports this idea. Therefore, there is currently no other way to enter the telecommunications market than providing DSM at first, and then expanding the service gradually as regulation becomes loose. Entergy is a holding company, and therefore it is natural for them to emphasize DSM activities for a driving factor of their telecommunications business.

A publicly owned utility, on the other hand, is free from the federal level PUHCA regulation and is regulated only on the state or local level. For example, the previously mentioned competing CATV service by Glasgow Electric Plant Board, Glasgow,

Kentucky, has been free from these restrictions. Central Lincoln People's Utility District is another example of telecommunications service by a municipal utility. It will construct a fiber network in the rural Oregon area to control load management, teaming with two independent local exchange carriers, Pacific Telecom and Pioneer Telephone [Eby, 1994]. They plan to expand their system into residences for DSM. The federal government does not regulate their project and the state regulators have also supported their entry into the telecommunications business. The area covered by these publicly owned utilities are small compared with that of investor-owned utilities, but it can be said that in a limited rural area, the construction of the NII has already been begun by either competition or alliance among municipal utilities and telecommunications companies.

The modification of PUHCA with regard to the utility entry into telecommunications service has been discussed since 1993. It has been proposed that utilities should be allowed to provide telecommunications services by establishing subsidiaries specifically for the service. EPRI forecasts that a change of current regulation will come in the near future. Even if the federal level regulation of utilities is changed, there are still many regulatory issues at the state or local level for utility's entry into the telecommunications market. Furthermore, once they do enter, they will be under the regulation of the telecommunications industry at the federal, state and local levels. Local competition in telecommunication has not been well managed in the United States so far, and there remain many issues to be solved such as funding for the universal service, equal access among all players, and telephone number portability. Regardless of these uncertainties, federal deregulation of PUHCA will definitely lower the initial hurdle for utilities to enter the telecommunications market.

3.5 Problems Analysis in the Case of TEPCO

From the situations described above, it can be said that TEPCO has been facing severe difficulties especially in conducting the telephone service. They are doing well in expanding their fiber networks as a backbone, but they are struggling with expanding the network to individual customer's premises and installing subscriber's networks by themselves.

The construction of NII requires not only backbone networks but also well organized subscriber networks. If TEPCO wants to be a player in the NII, they first must get their current telephone service in order. Therefore, an analysis of problems encountered in TEPCO's initial entry into telephone service will be useful for considering their future strategy in the NII. In the following section, first, major issues are listed and discussed through comparison with NTT, other telecommunications players and U.S. utilities, and then, causal relations among these factors are discussed.

3.5.1 Problems and Causal Factors

Visible Major Problems

There are two visible major problems:

(1) difficulties of making revenues, and

(2) difficulties in expanding subscribers beyond the point of critical mass.

The first problem emanates mainly from the second, but an additional causal factor is that TEPCO must set the telephone rates at a very low level to compete with NTT. NTT's rates for local calls are generally kept at a very low level by cross-subsidizing from the revenue of profitable long distance calls. The second problem has self-feedback loop because of network externalities. Subscribers do not increase because total subscribers with whom they can communicate are few.

Inherent Issues

There are two issues inherent in the background of TTNet's business:

(3) high installation cost of subscriber's networks, and

(4) TTNet's odd scale: local and limited long distance calls.

The installation cost of backbone networks is traffic-sensitive -- cost increases as traffic increases, meaning that traffic-sensitive cost can be easily collected charging according to traffic. However, the installation cost of the subscriber's networks is non-

traffic-sensitive and is generally too high to charge to each customer as a one-time fixed installation fee, regardless of the fact that it is optical fiber or copper. While NTT covered this cost partially from customers, and partially from subsidy tax as it was a public corporation, TEPCO installs this network itself and it does not pass the cost to customers as a fixed installation cost, to compete with NTT. This will be a heavy burden for TEPCO.

The second inherent issue for TTNet is that the scale of its telephone network is odd: it is not so small that TTNet can offer both local (intra-city) and long distance (inter-city and even inter-prefecture) calls, but it is also not large enough for the network to cover the whole of Japan, but only within the Tokyo metropolitan area. The network scale of TTNet seems to be large enough to compete with NTT within the limited area, but it is also so small that it covers only a part of NTT. This oddness of scale complicates both TTNet's rating strategy and MPT's policy-making.

Fatal Limitations

With regard to the second major problem, the difficulty in expanding subscribers, there are two fatal limitations as causal factors:

(5) access limitation with NTT subscribers, and

(6) communication area limitation.

Because the Japanese telephone network was installed by the monopoly, NTT, almost all current telephone users are customers of NTT, making it inevitable for general subscribers of newly-established telephone service providers to communicate with subscribers of NTT. Therefore, the first limitation, in which NTT's subscribers cannot reach TTNet's subscriber, is a fatal defect of TTNet's service for general subscriber.

The situation becomes worse when the first limitation is combined with the second limitation, in which TTNet's subscriber cannot communicate with NTT's subscribers outside the Tokyo metropolitan area. Regional telecommunications service does not always mean that communications begin and end within the region. The bypass business conducted by competitive access providers (CAPs) in the United States can be

managed because there is no limitation of communication area. Long distance companies want to connect CAPs to avoid paying expensive access-charges to local telephone companies. In the Japanese case, there is no way for long distance NCCs to see TTNet as a bypass partner under this limitation, which worsens the situation of TTNet.

Because of these fatal limitations, the telephone system of TTNet cannot serve as a general purpose telephone. Therefore, a customer regards TTNet's telephone not as a substitute for NTT's telephone, but as a second telephone unit. It is difficult for a general customer to estimate whether it is cost-effective to invest for the second telephone unit.

Governmental Policy Issues

Governmental policy issues form the background for every causal factor:

(7) Lack of coherent governmental policy for local telecommunications competition.

It is doubtful that the MPT had a robust policy regarding local competition when it allowed TEPCO to offer regional telephone service. At the 1985 telecommunications deregulation, MPT considered well about long distance competition and reformed the environment favoring the long distance NCCs, but MPT seems not to have expected new entries into the local telephone market and it had little knowledge of local competition. Because of this governmental problem, many issues of local competition remain unsolved, such as equal access, NTT's cross-subsidization, and communication area restriction. Therefore, the lack of coherent governmental policy regarding local telecommunications competition must be a big factor limiting growth of competition in local telecommunications market.

Problems in TTNet's Strategies

Last, but not least, TEPCO's and TTNet's strategies must be questioned:

(8) Lack of ambition and robust corporate strategy; reluctance in taking aggressive strategies.

It is difficult to assert such an issue because there is no comparable company in the region other than the giant competitor, NTT, and because TTNet is making every effort to pursue the business. However, compared with the attitudes of the three long distance NCCs who aggressively expanded their business and lobby the government, the behavior of TTNet appears to be always defensive and risk-averse.

For example, even in the current situation, two-way access with NTT could be realized by compensating for the additional costs to NTT, which might possibly have expanded the customer base of TTNet significantly. However, TTNet management did not take such a strategy because they feared increasing cost and deficit. The previously-mentioned official explanation of their purpose of the entry also shows their non-aggressive attitude.

It is unclear why TTNet could begin telephone service under so many predictable fatal difficulties and uncertainties such as regulation and access issues. While U.S. utilities first conduct pilot projects related to their core business before beginning regular telecommunications business, TTNet appears to have little idea of the mitigation of risk under such uncertainties. One risk mitigation strategy which TEPCO has taken is to outsource the maintenance of TEPCO's telecommunication networks to TTNet, but this strategy brings little other benefit to the TEPCO group companies from outside.

Therefore, it can be pointed out as an issue that the policies of TEPCO and TTNet reflect lack of ambition or robust strategies for success.

3.5.2 Causal Relations

The causal relations among the above-listed issues are complicated, which are presented in Figure 3.5.2-1. A list of these factors and detailed explanations about the causal relations are attached in the Appendix. The three salient features among these causal relations are as follows.

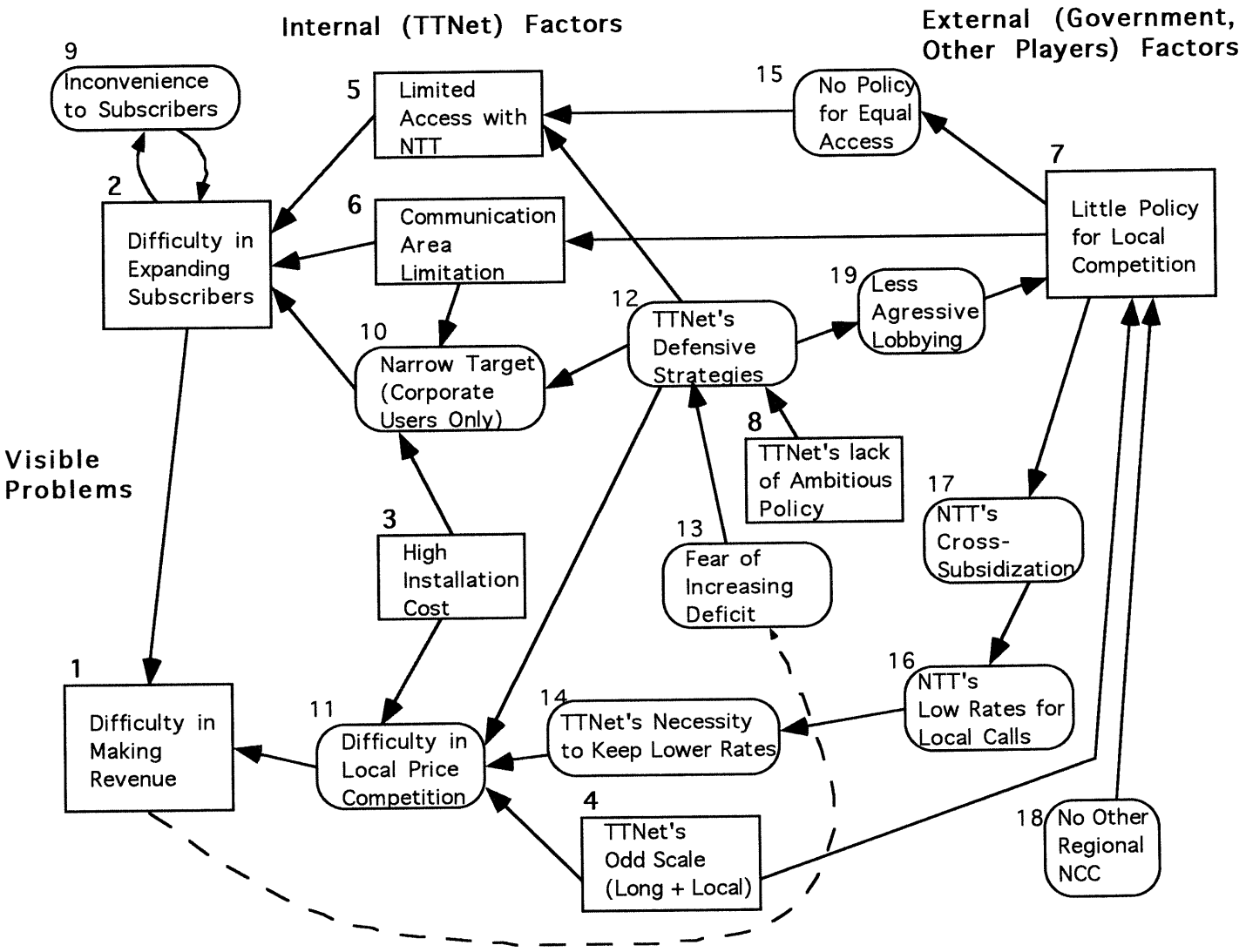

Figure 3.5.2-1 Causal Relations among Problems of TTNet's Telephone Service

Governmental policy as a fundamental issue

From analysis of these causal relations, it can be seen that the most fundamental issue is the lack of coherent governmental policy for local telecommunications competition. This factor affects every issue that causes major problems.

Positive feedback loops

The second feature is the three kinds of positive feedback loops in causal relations. A positive feedback loop is one characteristic of a dynamic system in which a situation is reinforced by the feedback. The first is a self positive feed-back loop in the first major problem, difficulty in expanding subscribers. In this loop, as subscribers increase, the customer base with whom a subscriber can communicate is expanded, which causes further increase of subscribers. In the case of TTNet, it is difficult to get new subscribers as the number of the total subscribers is not large enough to exceed the critical mass point.

The second kind of feedback loop includes the second major problem, difficulty in generating revenue. Because of this difficulty, TTNet fears increasing deficits, which causes reluctance in taking aggressive corporate strategies. Because of this reluctance, TTNet's corporate strategies become risk-averse, which ultimately causes difficulties in expanding subscribers.

The third loop is similar to the second one, except for its implication for governmental policy. Because of TTNet's reluctance in taking aggressive corporate policies, TTNet does not lobby the government to create a policy for local competition, which of course is the cause of every issue.

Corporate strategy as a breakthrough of the loops

To accelerate a positive loop into a "positive" or "desirable" direction that currently runs in a "negative" or "undesirable" direction, some breakthrough from outside is necessary. In this case, TEPCO must inevitably reconsider the current corporate strategies of TTNet as a breakthrough, instead of passively waiting for the change of governmental policy.

3.6 Summary

The national information infrastructure (NII) requires expansion of a broadband telecommunication network to every service subscriber. The installation cost of this last one mile is non-traffic sensitive and generally high. TEPCO has operated the telecommunications business with its optical fiber technology for about six years, but it has still been struggling with expanding the network to the last one mile in telephone service. Several enforced restrictions in their business such as service area limitation and limited access to the NTT telephone network, seem to be causal factors, but one fundamental problem is that the government allowed their business without creating a coherent policy regarding local telecommunications competition. These causal factors resulted in several positive feedback loops in which one problematic factor becomes further worsened by feedback relations of causal factors. TEPCO require some breakthrough strategies to reverse the flow direction of the feedback loops which is currently running in the undesirable direction.

While TEPCO faces severe difficulties in expanding the network to the last one mile, several utilities in the United States focus on DSM as an economic driver to expand its telecommunication networks to each customer premises. Governmental policies for the entry of utilities in telecommunications and for local telecommunications competition are not yet concrete in the United States, and utilities have not yet been allowed to conduct telecommunications businesses. Although the announced objective, DSM, does not always require broadband telecommunication technology, setting up the new business along with their core business is a good strategy to persuade regulators under the present uncertain regulation situation. This might be one solution for TEPCO.

Chapter Four

Future Strategies for Japanese Electric Utilities in the NII

The present situation and problems encountered in the telecommunications businesses conducted by Japanese utilities have been described in previous chapters. All utilities have successfully initiated the private leased circuit service; only one utility, TEPCO, provides regional telephone service, and has had severe difficulties in expanding the number of its subscribers. Almost all current customers of telecommunications services by utilities are corporate users.

In this chapter I focus on future strategies for use by Japanese utilities to pursue further telecommunications services, especially residential telecommunications service within the National Information Infrastructure (NII). The role of utilities in the NII is discussed first, followed by an analysis of possible corporate strategies.

4.1 Features of the NII in a Multimedia Market

There are two major features of the NII in a multimedia market:

(1) Convergence of mode will occur.

Emerging telecommunication and information technologies will diminish the existing boundaries between industries (such as telecommunications, broadcasting, publishing, computers, and other consumer appliances), which in turn will lead to increased competition within and beyond the existing boundaries. Every service that these industries provide is focused on individual rather than mass satisfaction, and therefore interactive services and customized services will increase.

(2) Many uncertainties exist.

Despite broad usage of the terms *NII* and *multimedia service*, many uncertainties make the future of the NII and the multimedia market appear vague and risky. There are three major uncertainty issues: standard technology, consumer demand, and government regulation.

First, standardization of telecommunication and information technology is a condition indispensable to realizing interoperability and to making every kind of service available to users with no redundancy of equipment. However, the pace of technological progress is so rapid that it is uncertain what technology will dominate the market at any given time.

Second, demand for the newly emerging services is still uncertain, although a dynamic relationship exists between consumer demand and market penetration of the service. There is always a danger of significant overcapacity of telecommunication networks.

Finally, governmental regulation remains uncertain. It is still unknown to what degree the government will allow the convergence of existing industries. Further, the government is currently addressing two ideas that support the construction of the NII: competition and universal service. However, these are mutually conflicting concepts that will not be easily resolved into one concrete policy.

4.2 Should Japanese Utilities Be a Player in the NII?

In order to allow every citizen to enjoy the benefits of the NII, it will be necessary to expand the broadband telecommunication network to all customer premises (as closely as possible) with low cost. It is with this in mind that potential network providers -- telecommunications companies and cable television operators -- are now planning their future strategies for rewiring, and the government is trying to arrange an appropriate environment to realize such infrastructure as universal and affordable telecommunications services.

This rewiring business is exactly what TEPCO and its telecommunications subsidiary, TTNet, have conducted and with which they have been struggling since they began telephone service six years ago because of governmental and the corporate policy constraints. Further, the two features of the NII mentioned above -- convergence and uncertainty -- are an unfamiliar environment for such a longlasting monopoly as the utility industry. Given these constraints, should Japanese utilities expand further telecommunications business and become an aggressive player in the NII?

Despite uncertainty about the future, the entry of Japanese electric utilities into the construction of the NII will have significance for the utility industry itself, the telecommunications industry, society (especially for residential users), and the government.

Significance For the Utility Industry

- *Economies of Scope*: Utilities can gain economies of scope by utilizing their internal telecommunications networks for outside purposes.

- *Customer Service Enhancement*: Customer communication applications offer more flexible, convenient, and rapid utility services to customers.

- *Utility Operation Improvement*: An extensively expanded network can increase reliability and speed of utilities operations while also reducing costs.

- *Additional Revenues*: Successfully diversified business practices can bring utilities an opportunity for additional revenues.

Significance For the Telecommunications Industry

- *Acceleration of Competition*: Entry of utilities that have as much technological and geographical potential as NTT will accelerate competition in the industry.

- *Prospective Partner*: For small telecommunications operators who want to compete with NTT, utilities could become a powerful partner who will share both risk and cost.

- *Cost Reduction*: Extensive deployment of optical fiber networks by utilities will reduce the unit cost of installation in general.

Significance For Society

- *Rate Reduction*: Consumers can enjoy rate reduction because of competition in the industry.

- *Diversified Service*: Consumers can enjoy further diversified telecommunications service menus because of increased competition in the industry.

- *Return the Benefit from Industrial Competition to Residential Customers:* Almost all NCCs focused on corporate users as their initial customers, but residential customers who contribute to the prosperity of telecommunications industry must be considered as well.

- *Universal Service*: Utilities have a universal service obligation in the utility industry. If they combine the construction of the telecommunication network with utility service, the idea of universal service for the NII can be realized more rapidly. Even customers in rural areas could soon benefit from the NII.

Significance For the Government

- *Accelerated Development of the NII*: Because of increased competition, NII construction will be accelerated.

- *Acceleration of Policy Making*: Governmental policy-making processes for new technology generally follow the actual industry activity. The entry of utilities into local telecommunications competition can be expected to accelerate the policy-making process of the government.

It is true that Japanese utilities have certain advantages for deploying residential optical fiber networks: technological knowledge, an abundance of skillful engineers, extensively-installed backbone networks, and resources for R&D. Also, utilities command the capacity for extensive regional customer information storage through the

utilities businesses, and this can be utilized to market other services. Most important, however, they have already (1985) cleared the initial regulatory barrier of entry, while US utilities are not yet allowed to enter this business. The technological evolution in the telecommunications industry is continuous and rapid, and can be expected to bring many future opportunities to utilities as well as the uncertainties discussed.

It might be thought that the first rewired cable to customer premises is also the last, because of the lack of cost efficiency. In such a case, the first installer of cable has a superior right to manage the service. If a utility plans to rewire, it must act now.

We have seen that Japanese utilities have the versatile potential to be a major player in the development of the NII, especially in residential telecommunications service market, and their entry into this business is strongly recommended.

4.3 Opportunities and Possible Strategies for a Utility

4.3.1 Utility's Options as a Player in a New Services Market

Under current regulations, a Japanese utility has three possible options in the emerging service market:

(1) **Utility Itself Option:** Service conducted by the utility itself.

A utility may conduct the new service independently if the service is regarded as a part of the utility's core business; there is no other player who can provide the service as well as the utility; and the regulator of the utility industry admits the service. In this case the utility must utilize its human power, assets, technology, and knowledge of its core business, and must directly flourish in its core business as well.

(2) **Main-Player Option:** Establish a subsidiary and be a major stockholder

In general, a Japanese utility must establish a subsidiary in order to conduct a side business. If the new service has a direct relationship with any part of the utility's core business, and the plan passes regulations, a utility may then

establish a subsidiary and become a major stockholder of it. In this case a utility should have strong capabilities to offer the new service -- in either its assets, human power, technology or knowledge -- that supports their core business, and this must indirectly benefit their core business.

(3) **Sub-Player Option:** Participates in an alliance with some capital and is a sub-player of the service.

If the new service has no direct relationship with any part of the utility's core business, but will bring direct benefit to the utility's side business or indirectly to the core business, it may invest its capital to establish a new alliance with other leading players and become a supporting player in the business. In this case the utility must not necessarily have any human power, technology or knowledge to support the new service, but some indirect benefit to the utility or the utility's subsidiary must be forthcoming. For example, if investment in the new business can stimulate the growth of a regional industry of which activities will flatten the demand curve of electricity, the investment will be justified. If the service becomes critical to a utility's business environment, then it may change the strategy from the sub-player to the main-player option.

In general, a utility has an opportunity to participate in the new service only if such participation will directly or indirectly help the utility's core or side business to flourish. The utility must then decide which option should be taken for the new opportunity, depending on the degree of relationship between the new opportunity and the utility's existing business environment.

4.3.2 Utility's Opportunity in the Multimedia Market

We will discuss a utility's opportunity to participate in the residential multimedia market by considering the overall market structure of multimedia and the utility, and the value chains between them.

Jon Hagel and Tom Eisenmann, principals at McKinsey & Co., originated the future multimedia landscape presented in Figure 4.3.2-1, in which seven market sectors exist [Hagel & Eisenmann, 1994]:

(1) Content creators (game software, movie/TV studios, recorded music, retail/mail order)

(2) Packagers (print media/publishers, computer information services, home shopping, ad agencies)

(3) Traditional distribution (local/interexchange telephone companies, print media, broadcast TV stations, movie theaters, video stores)

(4) Digital networks (local/interexchange telephone companies, cable television systems, cellular carriers satellite carriers)

(5) Gateway (on-line service providers such as CompuServe, America On Line, and Prodigy)

(6) On-premises distribution (local area networks, telephone wiring, electrical wiring)

(7) Devices (computers, software, consumer electronics, game players, set-top box)

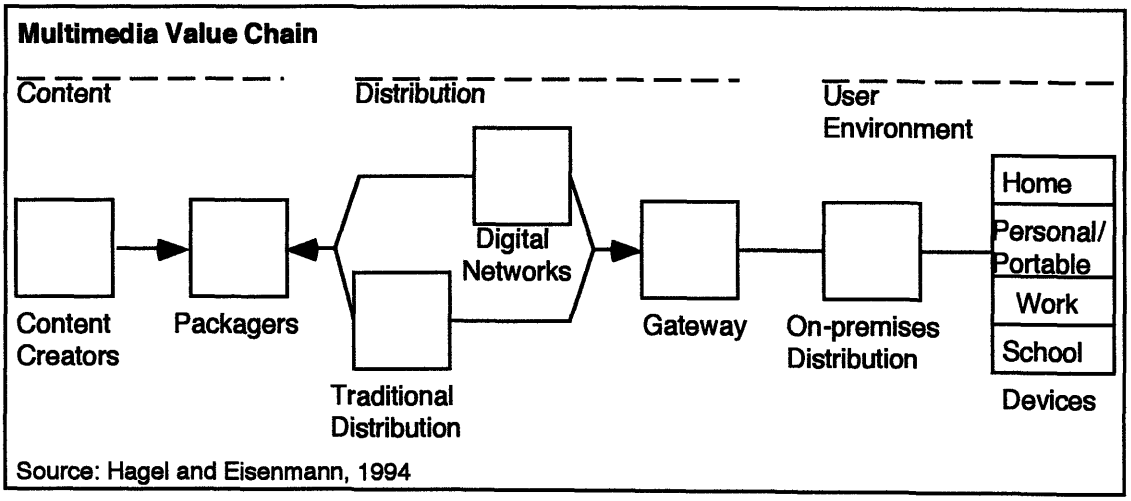

Figure 4.3.2-1 The Multimedia Landscape

Hagel & Eisenmann did not discuss the utility as a player, but when this landscape image is applied to the Japanese residential multimedia market with consideration of the

above-mentioned Japanese utility's options as a player, a specific value chain between utility and multimedia market will occur. Figure 4.3.2-2 shows the present situation of the Japanese multimedia landscape with utility participation. Japanese utilities have already participated in a part of the traditional distribution sector and a part of the digital networks sector, with a main-player option in which they have established a telecommunications subsidiary and utilized a utility's optical fiber network, technology, and personnel. Utilities participate also in the on-premises distribution sector by providing electrical wiring with the utility-itself option, and telecommunication wiring with the main-player option. There is no value flow other than monetary value from the multimedia market to the utility's core business.

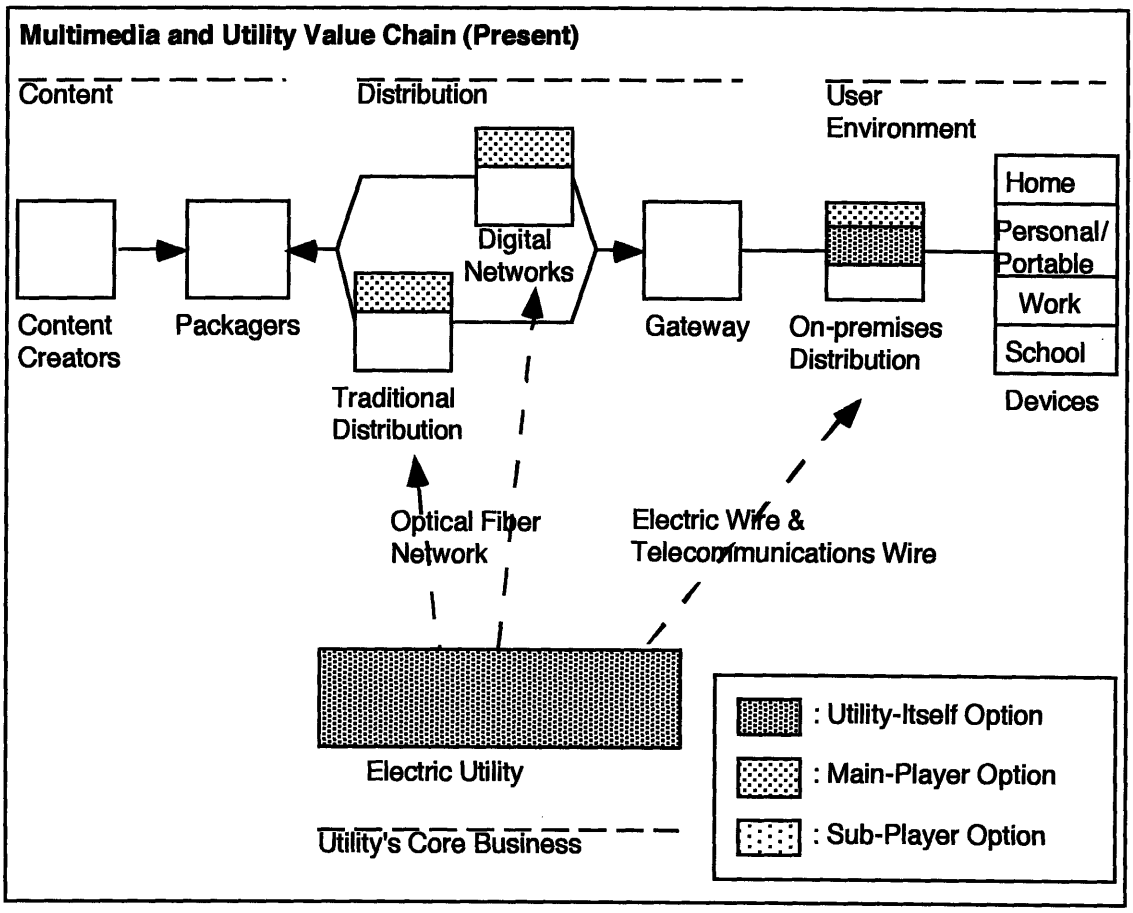

Figure 4.3.2-2 Multimedia Landscape and Japanese Utility (Present)

Adding to the utility's future opportunity to participate in every sector, Figure 4.3.2-3 shows the modified future multimedia landscape. As discussed in section 4.3.1, a utility has the opportunity to participate in each sector only if it will help it flourish in its existing business environment, that is, the utility's core business and telecommunication network service. If this condition is met, the Japanese utility will have certain opportunities in the overall multimedia market, not only as a conduit provider but also as a content provider, which will generate a return flow of the value chain to the utility.

A utility must first have an opportunity to make its existing telecommunications service a complete service that satisfies the general demands of its users. This is still the main-player option.

Second, a utility can participate in a part of the content creators' sector as a utility-related information provider. This can occur under the utility-itself option because providing energy information can be regarded as the utility's core business.

Further, utilities can participate in the on-premises distribution sector to provide new services such as home automation and home security, by utilizing its electric and telecommunication wire. This service will be conducted in cooperation with other players because utilities do lack background in this service; and this may therefore be the sub-player option.

Finally, the packagers and gateway sectors provide an additional opportunity, not directly to the utility's core business but to its telecommunications subsidiary and other telecommunications businesses mentioned above. The packagers make a package of several contents from content creators and provides it to each customer, while the gateway sector makes a package of the distribution media and provides it to each customer. Neither sector creates content, but they do integrate the disparate services. Furthermore, the gateway sector has a "high-ground" feature whereby every movement in the multimedia market can be grasped easily [Hagel & Eisenmann, 1994]. Utilities can participate in these sectors as a player which provides either a utility-related or a general package, but the latter would be better because of this sector's "high-ground" feature. This may be either the major-player option or the sub-player option.

The important feature of this landscape is the interaction of the value chain between the multimedia market and the utility. Customer interaction will become more important in the utility's core business, especially in demand-side management programs. By becoming a player in the packagers or gateway sector, customer utility and non-utility information obtained though these sectors will flow easily from sector to utility, which will further the utility's core business.

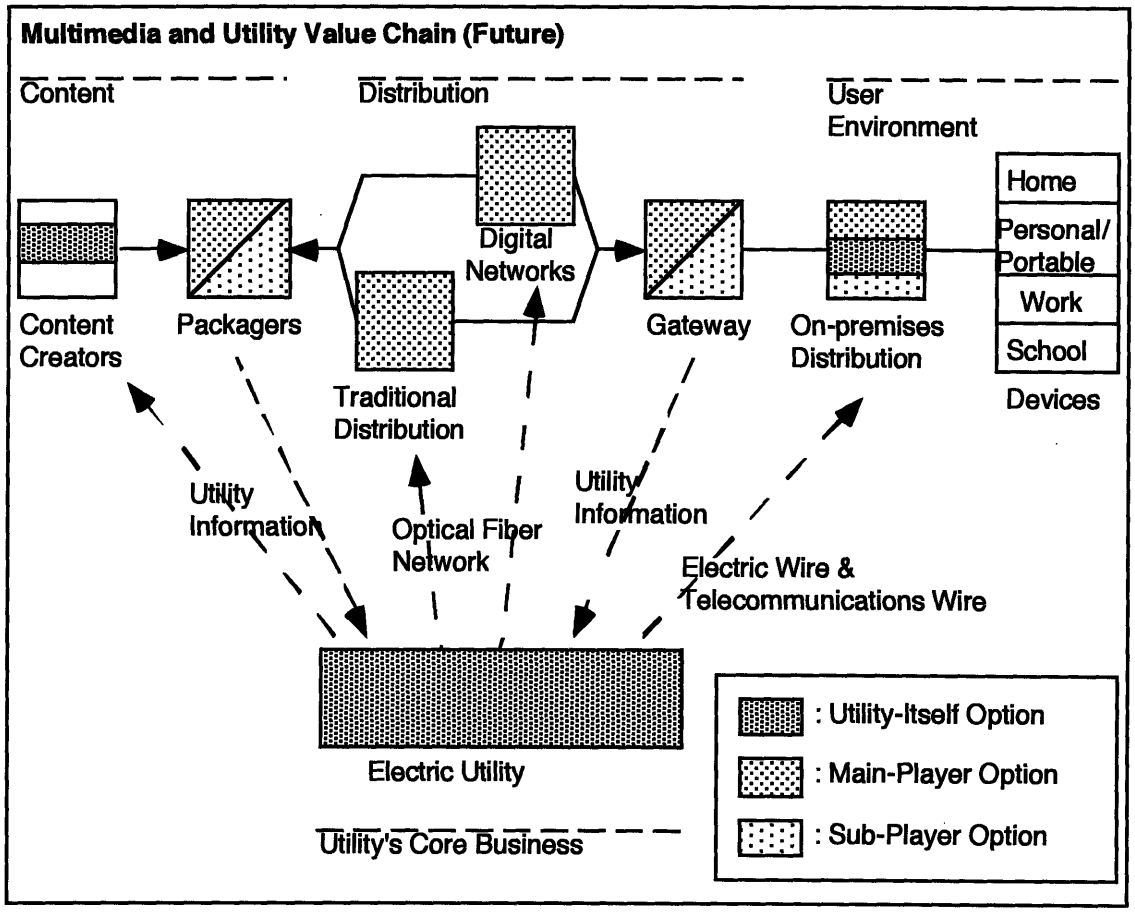

Figure 4.3.2-3 The Multimedia Landscape and Japanese Utility (Future)

In conclusion, with an integrated strategy that covers all sectors, utilities can participate not only in the distribution-related sectors but also in the multimedia market as a whole, because all sectors are dynamically interconnected by value chains.

The total-market-oriented strategy can be justified also by the results of a problem analysis presented in chapter 3. We have defined two main obstacles for a utility to expand its regional telecommunications service to residential customers: access limitation to NTT's telephone subscribers, and communication restrictions within a utility's service area. The former is a result of the failure of negotiations between utilities and NTT, while the latter can be attributed to governmental regulation. The best strategy is, clearly, to remove these limitations, but this will take time, and until these limitations are removed, utilities must provide differentiated services from NTT rather than price discrimination in order to compete with NTT in the regional telecommunications market. Therefore, a utility had best not limit itself to one service per sector, but should consider the total service market.

4.3.3 Utility's Possible Strategies

To realize the above-mentioned opportunities in the residential multimedia market, Japanese utility must consider three major strategies:

(1) **as a carrier** (basic telephone service)
(2) **as a utility information provider** (strategic utility service)
(3) **as a non-utility information provider** (full service)

The strategy that utilities must consider first is to offer basic telephone services, which TEPCO has been doing through TTNet. Because this strategy is conduit-oriented, a utility may choose the main-player option in the traditional distribution and digital network sectors in the multimedia market. Unlike US utilities, Japanese utilities already own independent telecommunications companies. To expand the network extensively to end-users it will be necessary to focus on telephone services as a core business and to expand the subscriber base. The telephone service itself requires only narrowband, but it is not necessary to decide whether the cable should be narrowband or broadband, because a broadband network carries also narrowband telephone service.

The second strategy is to use the utility's core service as an economic incentive to attract residential customers, which US utilities are presently doing. This strategy is content-oriented and a utility may take the main-player or sub-player option, and cover all

sectors except that of devices. A utility-affiliated telecommunications subsidiary can cooperate with its parent utility in the construction of residential loops, and can provide utility-oriented services such as DSM programs, automatic meter reading, and customer communication systems. Home automation system and home security system may be considered as services in this option because these are infrastructure for a family's life as well as utility.

The third and final strategic option is to provide non-utility services such as video on demand, interactive television, and other future multimedia services with appropriate partners. This strategy is also content-oriented and covers all sectors. A utility had best start with the sub-player option because a utility has little knowledge about related business technology and information at the outset. Although technological feasibility and regulatory issues for these services are uncertain, utilities' regional customer information storage and their extensively distributed sales offices will be of advantage to them.

4.4 Details of Two Major Strategies

In the three possible strategies discussed above, a Japanese utility can be a main-player in the first (basic telephone service) and second strategies (strategic utility service), while it will be a sub-player in the last strategy (full service). Therefore, the first and second strategies require a utility to consider the integrated detailed strategy beforehand as a leading player, while the last requires a utility investing broadly in prospective multimedia services, weighing industry trends in order to mitigate the risk, finding a good partner, and optimizing the opportunity.

Possible options of the first and the second strategies are discussed in the following sections on the basis of a utility's strengths, weaknesses, competitors, and regulatory barriers. Network architecture and detailed cost-benefit analysis are not included in this work.

4.4.1 Strategy as a Carrier (Basic Telephone Service)

4.4.1.1 Service Options

The regional telephone service frontiers, TEPCO and TTNet, have faced many difficulties in this service where they focused only on corporate users. Nevertheless, the environment of the telecommunications business is rapidly changing, and therefore, several diversified options can be considered in the present telephone service which did not exist at the initial entry of TEPCO. The issue of how these options can create a synergistic effect from options new to the basic telephone business will be critical. I will discuss six sub-options, as follows.

(1) **Status Quo Option:** Duplicates that which is presently conducted by TTNet; focuses on large corporate customers rather than small business operators and/or residential customers.

This is the simplest strategy, with high cost-effectiveness in the short term. However, because of many limitations, utilities will suffer the same difficulties that TEPCO has experienced. They must first achieve equal access to the NTT telephone network, and as soon as possible. However, their complete business activities will have to wait for deregulation of the communications area. Once these limitations are cleared they can expand subscribers. Then, as installation costs decrease, they can expand their target to include residential customers.

Another strategy is to do nothing until all uncertainties and limitations are removed. However, in Japan, governmental policy generally follows emerging technology pretty closely. Many players -- such as CATV operators and PHS service providers -- are willing to enter into local telecommunications competition, and once they enter the market, while the utility is just waiting, they will take a partnership with NTT, which increases the difficulty when the utility later attempts to enter. Therefore, the do-nothing strategy will not be recommended.

(2) **PHS Option:** Uses Personal Handy Phone System (PHS) to reach residential customers; connects PHS communication networks with the utility telephone networks.

PHS service can be used to expand the utility's telephone network to residential customers without installing costly cable to individual customer premises. Of course, this can be realized on condition that the PHS is provided through the utility's telephone network. This strategy depends on the growth of the PHS business, which all utilities will initiate this year (1995). PHS is expected to penetrate rapidly among private users, but this will depend on each PHS provider's business strategy. Although utilities must expand PHS networks extensively so that residential customers can conveniently use the system, the total network installation cost will still be lower than that of extensive telephone subscriber lines. Because initial PHS users will communicate more frequently with current telephone users rather than with other PHS users, it is still critical to remove both access limitation with NTT and communication area limitations, as soon as possible.

In the case of using NTT's network for PHS service as an initial strategy (as TEPCO and TTNet will do), a utility's telephone service network appears to have no relation to PHS service. However, the utility must extend its network extensively enough to be able to conduct PHS service, in order to prepare for the time when access limitation with NTT is removed. Once equal access with NTT is realized, the utility can use either its own or use both networks for PHS service, which will further increase the number of subscribers to the utility's telephone service.

(3) **CATV-Telephone Option:** Uses cable television network to reach residential customers; connects CATV cables with a utility's telephone network.

CATV-telephone technology will help utilities to obtain residential subscribers to telephone services. By using CATV's existing coaxial cable, or by sharing installation costs for each subscriber's cable with the CATV operator, utilities can reduce installation costs and expand their networks to individual customer residences. As discussed in chapter 3, TEPCO is currently conducting a trial project, CATV-telephone. Although future prospects for this service are still uncertain because the CATV industry in Japan is itself currently so small, utilities can expect to obtain certain amount of customers without equal access to NTT. There is a threat that CATV operators will choose NTT as a

telephone service partner because of the undesirable limitations of TTNet's telephone service. It is therefore still desirable that both limitations (limited access to NTT and limited communication areas) be removed as soon as possible.

(4) **Bypass Option:** Provides bypass service to long distance NCCs as CAPs in the United States.

Bypass services of local telephone companies are welcomed in the United States, both by interexchange carriers (IXCs) who can avoid paying high access charges to regional Bell operating companies (RBOCs), and by large corporate users who can reduce the cost of their long distance calls. This idea might be applied in Japan. To realize this, however, it is critical to remove the communication area limitation of regional NCCs. Once this limitation is removed, regional NCCs can be connected by long distance NCC, and the local network of NTT is bypassed on both ends. Equal access with NTT will of course be desirable in the early stage.

One present problem is that access charges in Japan are now so low that there is no urgent need for Japanese long distance NCCs to seek bypass service providers. The regulation in the number of the "point of interface" (POI) settings, which is limited one to a prefecture, will cause an additional problem where in some cases the cost might be higher than NTT's. However, because the MPT is currently reconsidering breaking up NTT and rebalancing the rates of long distance and local calls, the access charge system will probably be modified after the MPT's final decision. In that case, bypass will be a strategic option.

(5) **Nationwide Utility Telephone Network Option:** Connects every utility's regional telephone network directly with every other; provides end-to-end telephone service without using NTT or other long distance NCCs.

TTNet is currently asking the government to allow direct connection of the leased-circuits service provided by all regional utility-affiliated regional NCCs.[1] This idea

1 Kazuo Fujimori, President of TTNet, said that he was asking MPT to allow free connection with NTT in every city and free connection with regional utility-affiliated regional NCCs. See [Yamada, 1994].

should be applied to the emerging regional telephone service. Because each regional NCC will set the calling rate at a level lower than those of NTT and other long distance NCCs, direct connection will provide the lowest calling rate in Japan. However, MPT has not allowed this connection because the results would generate a fourth long-distance company -- and MPT limits the number of long distance NCCs to three. Strong objection can be expected from existing long distance NCCs as well. Furthermore, because the initial customer base of each regional NCC is so small, the solution to expand each utility's telephone subscribers is not viable unless access with NTT is not limited. Therefore, this strategy as a solution will be difficult to realize in the short term.

(6) **Computer Communications Option**: Provides connection via a narrowband telephone network to on-line information service providers who exist in fixed locations within each utility's service area.

On-line information services or personal computer communications services via telephone networks have become popular in Japan, not only among corporate users but also with private users.[2] Internet is also rapidly becoming popular among private users.[3] Unlike corporate users, most private users access Internet by dialing an access provider's server.

The cost of telecommunications tends to become very high for these residential subscribers of computer communications services, because NTT's telephone rating requires a metered rate system. Introducing low and fixed rates within the service area (as TTNet is doing) will be widely accepted by these users, especially those who live far from access points. This service will also be welcomed by on-line service providers who will be able to expand their customer base without installing many distributed access points.

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2 As of December 1992, there are 1.96 million subscribers of major domestic personal computer communication networks, a growth of 26% compared with the previous year. See [InfoCom Research, 1994a, p.203].

3 It was only October 1993 when the first commercial Internet linking service was initiated [Aoki, 1994]. The number of computers that have direct connection to Internet was about 82 thousand as of December 1994, with an annual growth rate of 400 % [Takemura, 1994].

By promoting a utility's telephone service to these computer network users, utilities can expect a certain expansion of subscribers who use the telephone for voice communication as well as for data transmission. The greatest merit of this strategy is that it allows the utility to expand its subscribers regardless of either limitation (limited access with NTT or communication area limitation), because the location of the information server is fixed within the communication area.

Future information communication service via telephone, as well as computer communication, will be targeted by this strategy. Video dialtone service, which will be conducted in the United States by Bell Atlantic, will be one option. A utility does not necessarily have to be a video service provider, but can be an access provider to the video server.

4.4.1.2 Evaluation of Service Options

The six service options presented above are further discussed with the following factors (see Table 4.4.1.2-1).

Partners

The PHS, CATV, bypass, and computer communications options can be realized with other service providers, while status-quo and the nationwide utility network option can be realized within utilities. Although NTT is definitely a competitor, it will in a sense act as a partner in the early stage because the utility telephone business must depend on full access to NTT's network.

Competitors

NTT is the largest competitor throughout all options, but wireless telecommunications service providers (such as cellular and PHS) can compete in local telecommunications competition. CATV operators who conduct telephone services will also compete if they do the business with NTT.

Installation Cost

Installation costs differ depending on network architecture. In general, the network architecture of the status-quo option, the nationwide utilities network option, and the computer communications option will be the same, with a relatively high installation cost. The network architecture that is required for the PHS option will differ from other narrowband subscriber loops, but it will be lower than the options discussed above. The network architecture for the CATV option will also differ from other options, and because a utility can use CATV subscriber lines or share with CATV operators the construction cost of subscriber lines, the total cost can be reduced.

Utility's Strength

Flexible rate-setting is a fundamental strength of utility-affiliated telecommunications subsidiaries for all options. Because they are independent from NTT, they can organize their rate systems apart from NTT's historical rate system. For example, TTNet is the first and the only company in Japan to provide a fixed rate telephone system within a service area regardless of the distance of the call. This fixed rate system provides a special advantage in the computer communications option. MPT has reported that the fixed rate system will be appropriated for future multimedia service.[4]

These systems can share the construction cost of backbone fiber networks with parent utilities, which will allow them to undercharge NTT.

4 MPT announced that it will introduce a fixed rate system for the future multimedia telecommunication network. The price will be around ten-thousand yen ($100) and it will start in the year 2000. (This announcement is an example of government deciding corporate strategy.) See [Yomiuri Shimbun, 1994b].

Table 4.4.1.2-1 Telephone Service Options

	1	2	3	4	5	6
Option	Status Quo/ Basic Telephone	PHS	CATV	Bypass	Nationwide Utility Network	Computer Communication
Subscriber's Network Builder	Utility	Utility and PHS	CATV	Utility	Utility	Utility
Backbone Network Builder	Utility (+NTT)	Utility (+ NTT)	Utility (+ NTT)	Utility and long distance NCCs	Utilities	Utility
Competitor	NTT, Cellular, PHS, CATV Telephone	NTT, Cellular, Other PHS	NTT, Other CATV Telephone	NTT, Cellular, PHS, CATV Telephone	NTT, Cellular, PHS, CATV Telephone	NTT, CATV Telephone
Network Installation Cost	High	Medium	Medium	High	High	High
Impact from Access Limitation with NTT	Very Strong	Very Strong	Strong	Strong	Strong	Weak
Impact from Communication Area Restriction	Very Strong	Strong	Strong	Very Strong	Very Strong	Weak
Regulatory Barriers	Area Limitation, Non-Equal Access	Area Limitation, Non-Equal Access	Area Limitation, CATV-Telephone Regulation	Area Limitation, Non-Equal Access	Area Limitation, Connection Limitation	---
Other Issues	---	Some Utilities Use NTT's Network	---	Little Incentive, Little POI	Objection from Long Distance NCCs	---
Time Frame	Mid	Short - Mid	Short - Mid	Mid - Long	Mid - Long	Short

Utility's Weakness

As discussed in earlier chapters, the most severe problems are limitations in telephone service: limited access with NTT and communication area limitation. Although the utility can provide a flexible rate system, it will find it difficult to attract customers because of these two limitations. The computer communications option is free from these limitations. The impact from access limitations is very high in the status quo option and the PHS option, while it is high in the CATV option, the bypass option, and the nationwide utility network option. The impact from communication area limitation is very high in the status quo option, the bypass option, and the nationwide utility network option, while it will be still high in the PHS option and the CATV option.

Regulatory Barriers

The lack of a coherent governmental policy regulating local competition limits the communications area and causes unequal access, the two largest regulatory barriers to all options except computer communications. In addition, the governmental policy on regional and CATV telephone services is not yet well organized, a barrier in the CATV option. Also, the restriction of connection among regional telephone networks of all utility-affiliated NCCs is the one largest barrier to the nationwide utilities network option.

All these barriers (except the last) may well disappear as the government organizes a competitive environment of local competition in the short-medium term (one to five years). For example, MPT now partially allows a connection between public switched networks and private leased circuits (April 1995), and this practice promises to remove the limitations in communication areas for utility-affiliated NCCs. Also, CATV-telephone will be admitted within a couple of years, and the government must have established a coherent policy on local competition before the service begins.

Time Frames

The short-term indicates a period of two years, while the medium-term refers to a period of from three to five years, and the long-term is a period of more than five years. The computer communications option will be a short-term strategy because it is free from the current service limitations. PHS and CATV will be short-medium-term strategies

because they are conducted with services that will emerge in the near future and are affected by both service limitations. The status-quo option might be a medium-term strategy because its full implementation must wait for the removal of both service limitations, but this delay will be a fatal problem for their future market expansion. The bypass option can be achieved by combining with other options (such as the PHS or CATV), but it will be a medium-long term strategy because there is currently little incentive to bypass the local telephone companies. Finally, the nationwide utilities network option will be a medium-long term strategy because the strong objection by long distance NCCs currently experienced will not disappear soon.

Summary

- Existing service limitations (limited access to NTT and limited communication areas) are severe issues that affect almost all strategies. A utility must make every effort to remove these limitations as soon as possible.

- Because each option supports basic telephone service from a different aspect and in a different time frame, it will be better to implement options as they becomes available.

- The computer communications option may be implemented first because it will not be affected by existing service limitations.

- CATV options can be implemented second because the impacts from service limitations are relatively weaker than in other options. PHS service may be implemented next, following the process of removal of existing service limitations.

- The bypass and nationwide utility network options may be implemented next in the medium-long term, after regulatory barriers have been removed.

- The status-quo option is not recommended because it will further delay the removal of existing limitations and also the delay will be a fatal problem for their future business.

4.4.2 Strategy as a Utility Information Provider (Strategic Utility Service)

4.4.2.1 Service Options

As optical fiber technology prevails, telecommunications quality becomes almost equal among all conduit providers, and the contents of the conduits then become important to attract users. Contents can also be an economic driver to rewiring the nation with broadband technology. Therefore, providing attractive contents will help utility's present telecommunications business that provides conduits.

The contents of the utility information service via residential telecommunication can be divided into three major options, as follows.

(1) Automated Meter Reading Option

This option deals with the electric meter interface, and its objective is to improve operation of the utility. The utility's closest point of contact with a customer is, at present, the electric meter. All operations with the meter are completed at the customer site, which requires large numbers of humanpower unless connected via telecommunication networks. The major applications of this option are automated meter reading (AMR), remote connection and disconnection of meter, and real-time meter monitoring,. These applications require only narrow-band capacity.

AMR has been thoroughly researched and experimented by Japanese electric utilities. TEPCO has been conducting pilot AMR projects since 1989 for about six thousand residential customers, in which three types of telecommunications technology are used: coaxial cable of CATV, NTT's telephone cable, and power distribution lines.[5]

The cost-effectiveness of AMR is currently the most pressing issue. The monthly cost of an AMR system per-meter is more than one-hundred times that of the monthly cost

5 Personal interview by the author with Kazuya Yamabe, Assistant to Manager, Information Systems Department, TEPCO.

of reading meters by humanpower (in the case of TEPCO), even excluding the cost of installing the cable.[6] Because a primary goal of operational improvement is cost reduction, it is difficult to justify widespread installation of the AMR system. On the other hand, AMR technology and the network infrastructure for AMR can be the base of every kind of utility's telecommunications services. Therefore, joint installation of AMR with other utilities (water, gas) reduces the installation cost, and implementing other automated operations (e.g. remote connection and disconnection) or other telecommunications services (e.g. load management) might help justify the installation cost. Andersen Consulting predicts that the benefit of AMR will become significant in the future fully competitive environment of the utility industry [Andersen Consulting, 1994].

(2) Residential Demand-Side Management Option

This option deals mainly with direct and indirect customer load management, an effort to reduce peak demand and flatten the demand curve. Direct load management allows a utility to control the customer's electric appliances (air conditioner, water heating, lighting). By providing dynamic pricing strategies such as time-of-use or real-time, indirect load management allows customers to control their own appliances. In the case of indirect residential load management the transmission data to customers will be large and frequent, but the transmission data from customers will be moderate -- unless real-time response is required for real-time pricing information [EPRI, 1994, p.6-20]. Therefore, broadband capacity is preferable but not necessarily required.

Many utilities in the United States believe that this option is the best prospective economic driver for the installation of telecommunication networks to residential customers. However, the Japanese environment of residential DSM is presently facing three major problems that make it difficult to deploy residential telecommunication networks: few pricing options, little penetration, and power plant construction rather than DSM.

First , there are few pricing options for managing residential loads. Both direct and indirect load management programs are, at present, options mostly for commercial or

6 Ibid.

industrial users because of the effectiveness of cutting demand per-contract. The only option for residential customers is time-of-use pricing mainly for the electric water heater. Real-time pricing, the most promising pricing technology, requires two-way telecommunication and has not been implemented in Japan -- it is still under research. Furthermore, because rate systems are strictly regulated by the government and utilities must obtain permission to change an existing or create a new rate system, they are not free or flexible enough to provide attractive pricing strategies. It will be necessary to provide more options for incentive pricing to residential customers in order to conduct efficient load management.

The second issue is the very small penetration of time-of-use pricing contracts among Japanese households (6.7% as of March 1993).[7] Consumer preference for direct and indirect load management is also uncertain because of the few options for incentive pricing.

The third issue is the determination of Japanese electric utilities to invest in the construction of new plants rather than expanding existing DSM programs. The load factor that indicates the usage rate of an electric power facility is lower than for other countries (France, Germany, the United States), but total demand for electricity is still increasing in Japan, which make managers think more about construction of new plants than they do about investment in DSM programs.[8]

If the present situation continues, it will be difficult to justify the installation of telecommunication networks for residential DSM, for the reasons discussed above. However, many factors predict that Japanese utilities will increase their interest in DSM in the near future. The major factor is the deregulation proposal currently under consideration, which is expected to be implemented in 1995-96. As discussed in chapter 2, deregulation will introduce competition to the utility industry, which will in turn press

7 The customers of night-only pricing for water heaters counted 2.63 million and the customers of time-of-use pricing introduced in 1990 numbered 58 thousand in Japan as of March 1993 [Federation of Electric Power Co. of Japan, 1993. p.59]. The number of households in Japan was 40 million as of 1990 [Management and Coordination Agency, 1993].

8 The load factor of Japan was 56.8%, while it was 62.9%, 68.6%, and 60.4% in France, Germany, and the United States respectively in 1990 [Federation of Electric Power Co. of Japan, 1993. p.312].

every utility to consider reducing costs and improving load factors, therefore DSM will certainly be considered. The reform of rate systems is said to be aimed at flattening the load curve [*Denki Shinbun*, 1995]. Should a utility want to change its rate system following deregulation, the only requirement will be to notify the regulatory commission of the plan, as opposed to obtaining permission. Following deregulation each utility will be more flexible to provide incentive rate systems than the past.

This strategy will become a certain option within the short-medium term as the importance of DSM increases among Japanese utility industry.

(3) Customer Service Improvement Option

This option offers the customer utility-related information service via one- or two-way telecommunication to improve the relationship between utility and customer. The purpose is not only to provide useful information to a customer, but also to collect further accurate and detailed customer profiles with which to facilitate marketing residential DSM programs. The option includes many services: rapid billing information, estimation of the electric bill, energy usage information, outage information, interactive energy service such as field service scheduling, energy information television programs, and so on. The telecommunication capacity requirement differs with each application. Services that have graphic interface, such as an energy information television program, will require broadband telecommunication, but otherwise the capacity requirement is moderate.

The attractiveness of these services to customers is an important feature. US data indicate that nearly 80% of households show interest in an interactive utility information service.[9] However, residential Japanese customer preferences about energy information are uncertain. According to the results of a five-year experimental project conducted by TEPCO, only 50% of households agree with the necessity for this system, and the actual number of accesses to the system was extremely low, average monthly accesses being

9 Jeff Frauenheim, President of Texas Systems, presented the research results of random telephone interviews with more than 2,000 households in the United States. His paper, entitled "Consumer Energy Management: Future Shock or Future Stock?" was presented in DA/DSM'95 at San Jose, CA on January 23, 1995. The research was originally conducted by FIND/SVP and Texas Systems. See [FIND/SVP and Texas Systems, 1995].

only once per-household.[10] This disappointing result came primarily from the obsolete nature of the information provided. In this project, the only periodically-modified information, which was also the most accessed information, was about electricity usage. TEPCO's system analysis was mainly supplier-oriented and did not consider customer-oriented service at all.

As the necessity for residential DSM increases, the necessity for interactive customer service will increase correspondingly. Interactive services, such as providing more detailed pricing information to customers and gathering responses from customers, will help further the flexibility of DSM programs. Therefore, the demand for this type of service will increase as competitiveness and the necessity for residential DSM increase.

One of the most effective strategies for a utility-affiliated telecommunications subsidiary to adopt is that of marketing not only their parent utility but also various energy information service providers. This is the partial "high-ground" strategy in the package sector, which includes only utility-related information. It can generate an electronic brokerage effect in the long run, as seen in the case of SABRE, the reservation system used by American Airlines. SABRE allows the travel agent to locate and book flights, including flights of *all* airlines, with American flights listed first. Using this strategy, the system penetrates widely to travel agencies; it has become widely acknowledged that with SABRE the proportion of tickets booked is much higher for American than for other airlines [Malone et al., 1994; Venkatraman & Zaheer, 1994].

4.4.2.2 Evaluation of Service Options

Two sub-options are selected for each service option and are discussed with the following factors (see Table 4.4.2.2-1).

10 TEPCO conducted an experimental project on customer service systems via broadband telecommunication systems to 99 households in a newly developed apartment house between 1989 and 1994. The systems included AMR, CATV and an energy information system.

- Automated Meter Reading
  - (1) Automated Meter Reading
  - (2) Remote Connect/Disconnect

- Residential Demand-Side Management
  - (3) Direct Load Management
  - (4) Indirect Load Management

- Customer Service Improvement
  - (5) Electric Billing Service
  - (6) Interactive Utility Information Service

The Utility's Role in Each Sector

For any option, a utility can be a main-player in the traditional distribution sector and the digital networks sector with its telecommunications subsidiary, and it can be a main player in the on-premises distribution sector with electric power wiring and telecommunication wiring. All options require specific devices at the customer premises, but Japanese utilities are prohibited from manufacturing such equipment, and therefore can only be a sub-player in the device sector.

With regard to the indirect load management sub-option, a utility itself must provide pricing information to customers as a player in a content creators sector. It will also provide utility-related information for the customer service improvement options as a player in a content creators sector.

There are three strategies that a utility might consider for the customer service improvement option: provide its own information only; provide package information for all players in the utility industry; and provide package information for utilities and non-utilities. In the first case the utility need not play a role in the packagers or the gateway sectors, while it will be a main-player in the second case and a sub-player in the third.

Telecommunication Capacity

In general, the telecommunication capacity requirement is low or moderate. With regard to the indirect load management sub-option and the interactive utility service sub-option, capacity requirements will rise if the service requires real-time responses from customers or graphic user interface.

Partners

For all options, the parent utility company is the most reliable partner for its telecommunications subsidiary. For AMR options, gas and water utilities will share the installation cost.

For customer service improvement options, companies in the home automation and security industries will be partners because almost all services in these industries require local area networks to the customer premises, and the installation costs are therefore shared.

Competitors

For all options, all players who can sell electricity will compete because they can attract customers by providing energy-related information via telecommunication networks. Therefore, as the degree of competitiveness increases, individual power providers, power retailers, and other energy industries (e.g. gas) will become competitors. However, as telecommunication conduit providers, these players also become its users or partners.

Installation Cost of Telecommunication Network

The cost of installing a telecommunication network differs depending on application, but the cost to the individual is moderate because it is shared among telecommunications subsidiaries, the parent utility, and other partners. If high capacity is required, the installation cost will become relatively high.

Table 4.4.2.2-1 Strategic Utility Service Options

		1	2	3	4	5	6
Options		Automated Meter Reading		Residential DSM		Customer Service Improvement	
Sub-Options		AMR	Remote Connect/ Disconnect	Direct Load Management	Indirect Load Management	Electric Billing Service	Interactive Utility Service
Utility's Role in Each Sector	Content Creators				Utility	Utility	Utility
	Packagers					Main/Sub	Main/Sub
	Trad. Distribution	Main	Main	Main	Main	Main	Main
	Digital Networks	Main	Main	Main	Main	Main	Main
	Gateway					Main/Sub	Main/Sub
	On-premise Dist.	Main	Main	Main	Main	Main	Main
	Devices	Sub	Sub	Sub	Sub	Sub	Sub
Capacity Requirement		Low/Moderate	Low/Moderate	Low/Moderate	Moderate/High	Low	Moderate/High
Partners		Parent Utility, Gas, Water	Parent Utility, Gas, Water	Parent Utility	Parent Utility	Parent Utility	Parent Utility, Security, Home Automation
Competitors		Other Utilities, Individual Power Providers	Other Utilities, Individual Power Providers	Other Utilities, Individual Power Providers	Other Utilities, Individual Power Providers	Other Utilities, Individual Power Providers	Other Utilities, Individual Power Providers
Network Installation Cost		Mid	Mid	Mid	High/Mid	Mid	High/Mid
Systems Installation Cost		Mid	Mid	Mid	High	High	High
Benefits for a Utility		Low - Mid	Low - Mid	Mid - High	Mid - High	Low - Mid	Mid - High
Issues in the Telecom Industry Side		Technology Selection	Technology Selection	Technology Selection	Technology Selection	Technology Selection	Technology Selection
Issues in the Utility Industry Side		Cost-Benefit	Cost-Benefit	Little Preference	Little Incentive Pricing Option	Trad. Billing Regulations	Attractiveness of Information
Other Comments		Basis of Other Services	Joint Installation with AMR	---	Needs More DSM Price Options	Join Installation with Others	---
Time Frame		Short - Mid	Short - Mid	Short - Mid	Mid - Long	Mid - Long	Mid - Long

Installation Cost of Utility Systems

The AMR system will be the basis of all other options except the direct load management sub-option, which can be installed separately. Therefore, if the installation cost of AMR can be regarded as moderate, the system cost of the indirect load management sub-option and customer service improvement options will be relatively high.

Benefits for Utility

The benefit for a utility company includes the direct monetary benefit (such as cost reduction, load factor improvement, and operation efficiency improvement), and the indirect benefit (such as service discrimination against competitors and the increase of customer attractiveness). The benefit differs depending on the situation where the system is installed, and on the degree of competitiveness. Benefits from AMR options will come mainly from cost reduction, and will differ depending on the installation area. The degree of cost reduction by AMR will be relatively high in rural and under populated areas and in large apartment buildings, but is generally low to medium in most other urban settings. Benefits from DSM options will be from moderate to high if the utility can provide attractive price options to customers and improve load factor effectively. Benefits from customer service improvement options will be mainly the indirect benefit and from moderate to high if the provided information can help other utility activities such as DSM. For any option, the benefit will increase as the degree of competitiveness in the utility industry increases.

Issues for the Telecommunications Industry

There will be few regulatory barrier for these options in the telecommunications industry if the activities can be clearly divided into those of a utility itself and those of its telecommunications subsidiary. The service area limitation that exists in the telephone service conducted by a utility-affiliated subsidiary will not affect these activities. However, it will be most difficult to make a decision about the selection of technology (such as telecommunication capacity and network architecture) because capacity requirement changes depending on each application and its combination. For example, a wireless network is presently the most cost-effective way to realize AMR, but it is

difficult to apply this network to other applications such as the indirect load management sub-option. Information and telecommunication technology evolve rapidly, which makes decision making much more difficult.

Issues for the Utilities Industry

For a utility, the installation per-customer cost is still relatively high throughout all options, and therefore justification is difficult if a sub-option is installed by itself. It is difficult to deploy a system simultaneously throughout the service area, at the same speed, and with the same structure, because cost-effectiveness differs from region to region. Residential DSM and customer service improvement options deal with specific issues, questions such as consumer preference and governmental regulation in pricing and billing.

Time Frames

Because capacity requirements and installation costs of the AMR and direct load management sub-options are relatively low, and moreover they have no regulatory barriers, these options can be realized in the short-medium term. On the other hand, because other options require additional installation cost and/or must remove the regulatory barriers, they can be realized in the medium -long term. However, because for all options it is difficult to select a specific technology, the utility had best start an experimental project as soon as possible to seek the optimal strategy, even for the medium-long term options.

Summary

- As competitiveness in the utility industry increases, these strategies increase in importance to the individual utility.
- The telecommunications capacity requirement will not be so high in general.
- A utility-affiliated telecommunications subsidiary can share the installation cost with the parent utility.

- Because the installation cost of the system remains high, it is best to implement a combination of strategic options that share a common infrastructure.

- A utility is better off first to implement AMR options because a utility's telephone network can be used and there is no regulatory barrier. Because benefit from AMR options is relatively low, a utility should deliberately select the area of installation where the benefit of AMR can be maximized (such as newly developed residential area). The infrastructure for AMR options must be easily upgraded for the future usage by other options.

- At the same time, a utility had best start experimental projects of the residential DSM and customer service improvement options in order to define the most appropriate technology for the common infrastructure and to understand consumer preferences. With these preparations, a utility can start providing options smoothly, as regulatory barriers are removed.

- When a utility initiates customer service options, it had best conduct services in the packagers or gateway sector to be able to see the industry's movement as a whole and to gain "high-ground" advantage.

4.5 Summary

Although the NII project and future multimedia markets include uncertainties, the entry of Japanese electric utilities into residential telecommunications service in the NII will bring significant benefits to the utility industry, to the telecommunications industry, to society, and to governmental policy, and therefore, utilities are well advised to play a role in the construction of the NII. A utility should choose from the three patterns of participation (utility itself option, main-player option, or sub-player option), depending on the relationship between the new and existing services (the utility's core business and the telecommunications business conducted by utility-affiliated subsidiaries).

There are three major strategies a utility must consider at the same time. The first one is a strategy as a carrier of basic telephone service. To expand the network extensively to end-users, it will be necessary to focus first on telephone service as a core telecommunications business. The second one is a strategy as a utility information

provider. A utility can use utility's core business as an economic driver to deploy extensive telecommunication networks. The last one is a strategy as a non-utility service provider. Because the environment of the telecommunications industry is changing so rapidly, it will be necessary to invest broadly in prospective multimedia services, weighing industry trends in order to mitigate the risk, finding a good partner, and optimizing future opportunity.

Chapter Five

Conclusion

In this final chapter, I summarize future telecommunications strategies for utilities discussed in the preceding chapters with six factors (who, why, where, what, how and when) as a recommendation for Japanese utilities to play a role in the construction of the NII

Background (Who is the player?)

The players are Japanese electric utilities. Nine of ten Japanese utilities entered the regional telecommunications market through subsidiaries after the 1985 reformation of the market. At present, only one utility, the Tokyo Electric Power Co. (TEPCO), provides regional telephone service, but it has had severe difficulties in expanding its subscribers and revenue.

Two service limitations cause these problems. The first one is access limitation to the telephone network of the Nippon Telegraph and Telephone Corp. (NTT). NTT is a long-lasting monopoly both in the local and long distance telephone service, and it is difficult for a utility's new telephone service to exceed the critical mass point of subscribers (10%) without full interconnection with NTT. The second limitation is communication area limitation. The communication area of utility's telephone service is strictly restricted within the utility's service area. The first limitation is caused by a failure in the negotiations between a utility and NTT, while other limitations forced by governmental regulation. However, both problems are fundamentally emanated from lack of coherent governmental policy regarding local telecommunications competition.

Reason (Why should a utility be a player in the NII?)

Although the present regional telephone service includes many limitations and the NII projects and future multimedia markets include many uncertainties, the entry of

Japanese electric utilities into residential telecommunications service in the NII will bring significant benefit to every related sector. For the utility industry, it will yield economies of scope, customer service enhancement, utility operation improvement, and additional revenues. For the telecommunications industry, it brings acceleration of competition, prospective partnership for small telecommunication players, and construction cost reduction. For society, it will bring rate reduction, diversified service menus, and rapid realization of universal service. For governmental regulation, it will accelerate the development of the NII and accelerate the policy making regarding local telecommunication competition.

The elimination of current service limitation will also be accelerated by their continuous aggressive activities in the regional telecommunications market. Adding their potential of technology and know-how regarding the optical fiber, therefore, utilities are well advised to play a role in the construction of the NII.

Market Sectors (Where can a utility be a player?)

Given that there are seven market sectors exist in the future multimedia industry [Hagel & Eisenmann, 1994], a utility should be a player in every sector. The seven market sectors include content-oriented sectors (content creators, packagers), distribution-oriented sectors (traditional distribution, digital networks, gateway), and user environment sectors (on-premises distribution, devices). Currently, Japanese utilities are players only in a part of distribution-oriented sectors. However, participation in every related market sector is recommended, because every sector is connected by value chain and positive interaction among these sectors can be expected. Further, additional value flow from the multimedia market to the industry market will occur. Therefore, a utility needs an integrated strategy that covers every sector.

In each sector, a utility should choose from the three patterns of participation (utility itself option, main-player option, or sub-player option), depending on the relationship between the new and existing services (the utility's core business and the telecommunications business conducted by utility-affiliated subsidiaries).

Strategic Options (What can a utility do as a player?)

There are three major strategies a utility must consider at the same time. The first one is a strategy as a carrier of basic telephone service. To expand the network extensively to end-users, it will be necessary to focus first on telephone service as a core telecommunications business.

In this strategy, there are six options: (1) status quo option where a utility focuses only on corporate users, (2) personal handy phone system (PHS) option where a utility use PHS to increase subscriber's base of telephone service, (3) cable television (CATV) option where a utility uses CATV network to reach residential customers, (4) bypass option where a utility provides bypass service to long distance carriers, (5) nationwide utility network option where every utility connects its regional telephone network directly with each other, and (6) computer communication option where a utility provides access method to computer servers such as on-line services and Internet.

The second one is a strategy as a utility information provider. A utility can use utility's core business as an economic driver to deploy extensive telecommunication networks. In this option, there are three major options: (1) automated meter reading (AMR) option where a utility installs telecommunication network with electric meter interface for operation improvement, (2) residential demand-side management (DSM) option where a utility provides direct and indirect load management programs to residential customers, and (3) customer service improvement option where a utility offers utility-related information service via one- or two-way telecommunication.

The last one is a strategy as a non-utility service provider. Utility can offer non-utility service in the multimedia market such as interactive television and video-on-demand. Because environment of telecommunications industry is changing so rapidly, it will be necessary to invest broadly in prospective multimedia services, weighing industry trends in order to mitigate the risk, finding a good partner, and optimizing future opportunity.

Strategy Recommendation (How and when should a utility conduct the options?)

Figure 5-1 shows a time frame of strategic options for a utility, with possible outside events in the telecommunications industry, the utility industry, and the technological progress.

Two factors are critical to the successfully integrated strategy for a utility. The first key factor is to initiate service where the utility can be a main player from the outset, in order to make the telecommunication core business succeed. It is also critical to start broad and shallow investment in the services where the utility will be a sub-player, in order to establish good partners and lay the groundwork for further opportunities.

The second key factor is to initiate options, as thoroughly and as promptly as possible, because all opportunities and all sectors in which options exist are constantly and dynamically interacting. By combining several options that require a common infrastructure, cost-effectiveness is increased. If an option cannot be considered because of barriers, a utility had best start experimental projects to solve the technological uncertainties and define customer preferences. Action will gradually remove the limitations and barriers, because every factor (even government regulation) interacts with every other factor. Continuous advance in every option will be recommended.

In consideration of the two factors discussed above, a utility had best first become a major player in basic telephone service in order to increase its already-begun telecommunications business. Because the existing limitations experienced by TTNet have so strong an impact, a utility would be wise to choose a strategy that will not be affected by these limitations (such as computer communications), while it should also make every effort to remove the limitations. Strategies of a combination service with telephone service (such as PHS, CATV) would be a good strategy for reaching residential customers.

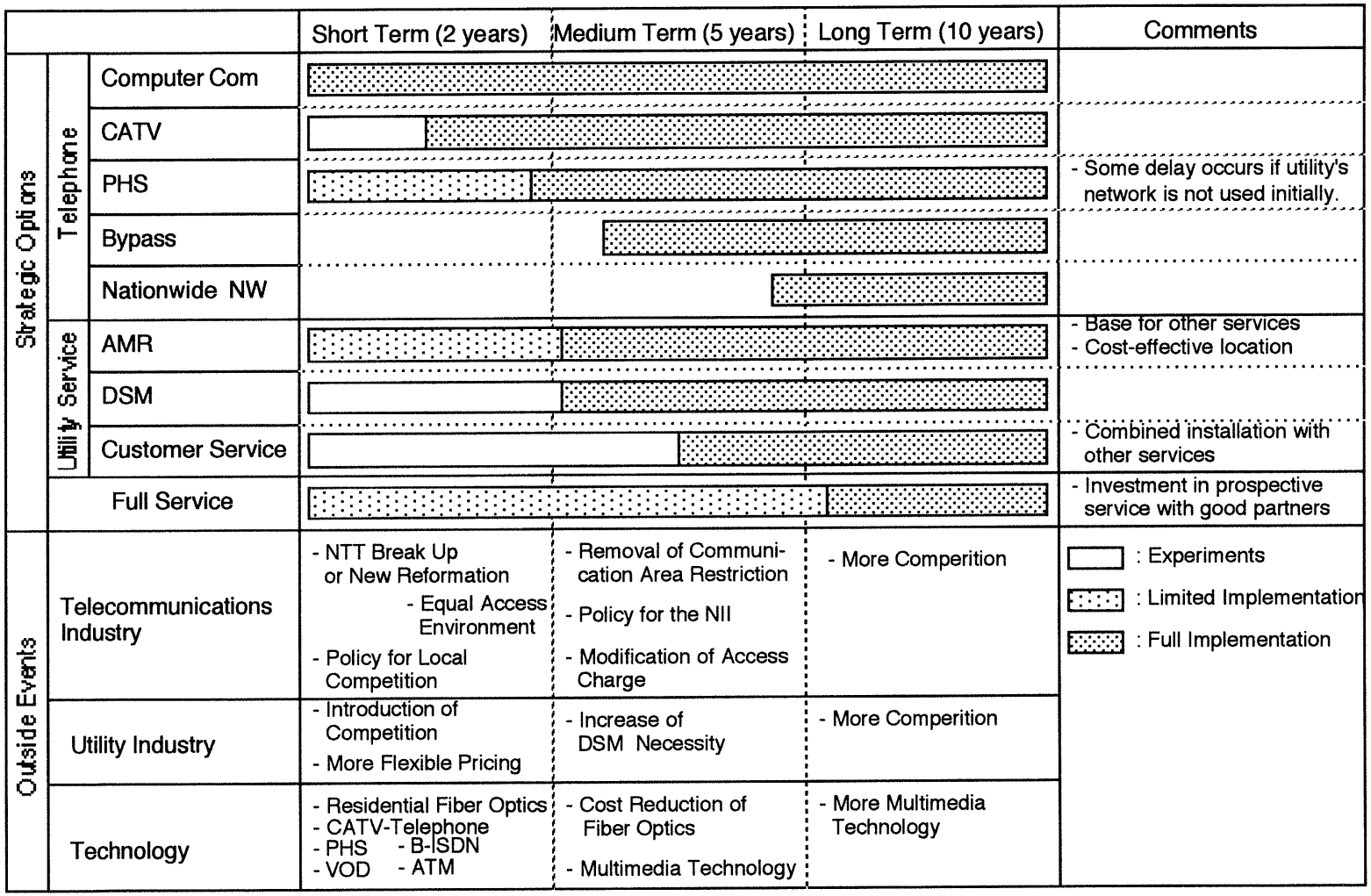

Figure 5-1 A Time Frame of Strategic Options and Outside Events

A utility had then best enter the utility-information service, as a strategy for the competitive utility industry. AMR will be the first options to consider, because of their moderate capacity requirement and freedom from regulatory barriers, but it is important to maximize the benefit of AMR by selecting appropriate location for installation. DSM and customer service improvement options will require an initial experimental project because they have a lead time within which regulatory barriers are removed. Consumer preference data can be obtained during this lead time which will make it easier to start the actual services.

Finally, a utility had best begin investing broadly in prospective services and in every sector in the residential multimedia market. This should indirectly nourish the utility's core business, or the core business of the utility-affiliated telecommunication subsidiary.

If a utility finds, through this broad and shallow participation, that the service becomes critical to its existing business environment, it may become a main-player and take the lead in the alliance.

Conclusion

Each of the three strategies (telephone services, utility-related services, and non-utility services) will bring opportunities for Japanese electric utilities to be a player in every sector in the future multimedia market. By initiating services where it can be a main player from the outset, and by initiating all constantly interacting options as promptly and as thoroughly as possible, a utility will successfully get its future telecommunications services in order.

This strategy will not only bring the utility such benefits as economies of scope and operation improvement, but also bring its customers such benefits as enhanced customer services, diversified services and rate options. It also will accelerate the removal process of existing regulatory barriers and accelerate the realization of the NII through successful competition in the telecommunications market. This will bring social and economic benefits to the nation. Therefore, Japanese utilities are well recommended to conduct a residential telecommunications business and participate in the construction of the NII.

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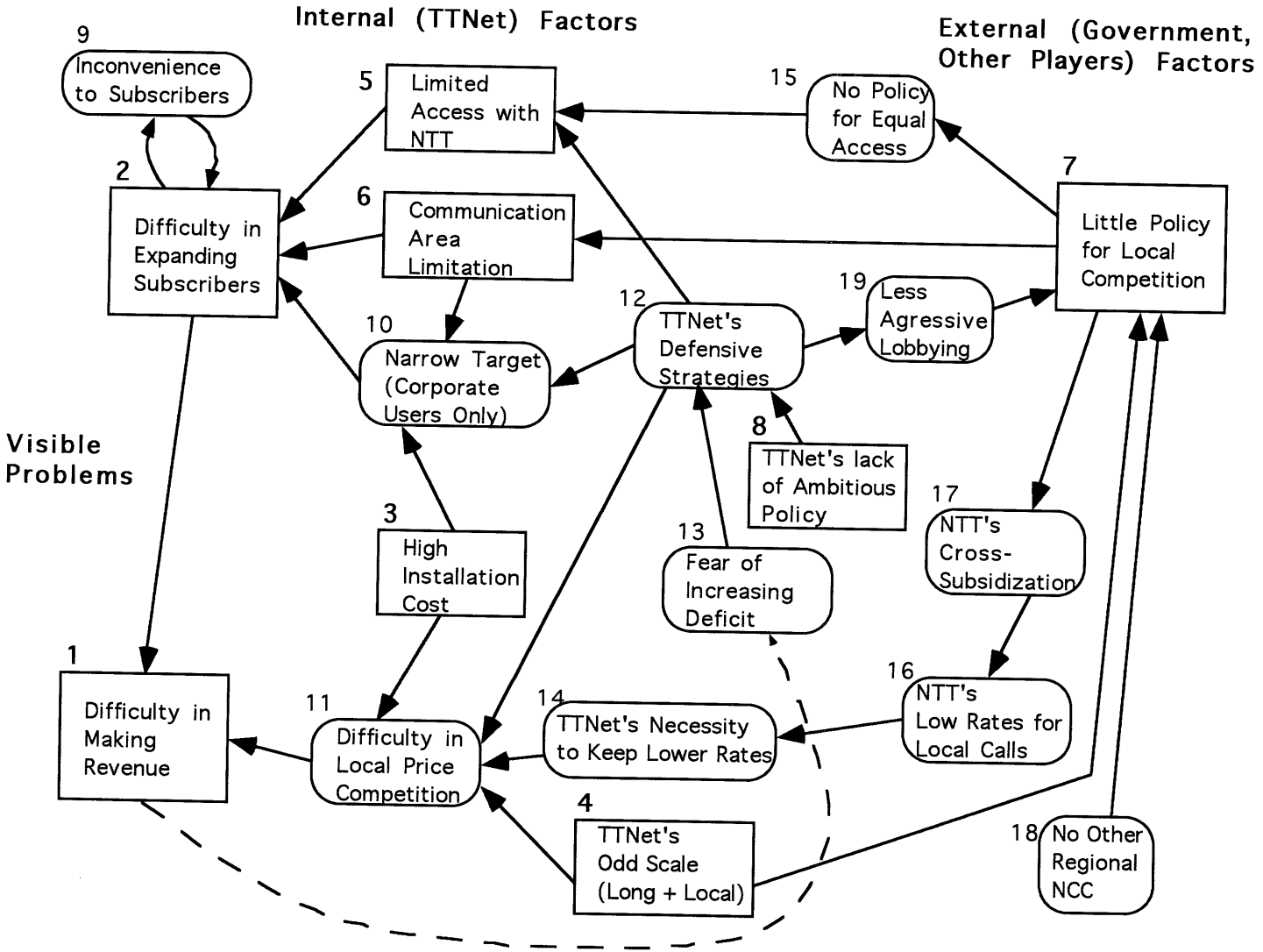
Appendix

Causal Relations among TEPCO's Problems in the Present Telephone Service

This Appendix explains the causal relations among the problems of TEPCO and TTNet's present telephone service as described in the section 3.5.1.



Causal Relations among Problems of TTNet's Telephone Service

List of Problems and Causal Factors

<Visible Major Problems>

(1) It is difficult to make revenues.

(2) It is difficult to expand subscribers.

(9) There is significant inconvenience to subscribers

<Internal Causal Factors (TTNet's Problems)>

(3) Installation cost of subscriber's network is very high.

(4) TTNet's scale is odd; it is not so small but not so large.

(5) Only one-way communication with NTT subscribers is provided.

(6) Communication area is limited within the Tokyo metropolitan area.

(8) TTNet is lacking in ambitious corporate policy for success.

(10) Target customers are narrow (only corporate users).

(11) It is difficult to keep rates low in the local price competition.

(12) TTNet takes defensive strategies.

(13) There is a strong fear of increasing deficits.

(14) TTNet must keep the rates lower than those of NTT.

<External Factors (Governmental & Other Players' Problems)>

(7) There is little coherent governmental policy regarding local competition.

(15) There is no equal access policy.

(16) NTT's rates for local calls is relatively low.

(17) NTT cross-subsidizes local service from long distance revenues.

(18) There is no other regional telephone provider.

Detailed Explanations

The visible major problems are (1) difficulties in making revenues, and (2) difficulties in expanding subscribers. Problem (2) is a causal factor of the problem (1). There is a feed-back loop in the problem (1) in which new subscribers do not increase because the number of total subscribers who can communicate with each other is so small that (9) subscribers experience significant inconvenience. This condition will

continue unless the number of subscribers exceed the critical mass point. This cause-and-effect is a feature of the network externalities of a telecommunication network.

The internal causal factors of the major problem (2), difficulty in expanding subscribers, are service limitations, including (5) only one-way access with NTT, and (6) communication area limitation. Factor (5) emanates from the failure of negotiation with NTT, but the fundamental problem is an external factor (15), lack of governmental policy for equal access. Factor (5) also emanates from (12) TTNet's defensive corporate strategies. This limitation would disappear if TTNet were to compensate for the additional cost of NTT regardless of possible deficit. TTNet was reluctant in taking such an aggressive and uncertain policy because of (13) fear of increasing deficit, and also because of (8) lack of ambitious policy. Factor (13) emanates from (1) difficulty in making revenue, therefore generating another feed-back loop.

Another factor that causes (2), difficulty in expanding subscribers, is (10) narrow target customers. TTNet currently targets only corporate users. This is due partially to (6) the communication area limitation, and (3) high installation cost of subscriber's networks, which is fixed cost regardless of the frequency of usage and the number of subscribers. Because TTNet must increase cost-efficiency, it must inevitably narrow the target. Factor (12), TTNet's defensive corporate strategies, also contribute to factor (10).

An internal causal factor of problem (1), difficulty in making revenue, is (11) difficulty in keeping low rates in local competition. This occurs because of (3) high installation cost, and (14) TTNet's necessity to keep lower rates to compete with NTT. Factor (14) becomes more severe because of (16) NTT's relatively low rate of local calls, which is caused by (17) NTT's cross-subsidizing policy. The revenue of the local telephone service of NTT has been in the red under the current rate system, and NTT cross-subsidized the deficit from the income of long distance calls. It can be

said that NTT's rates of long distance calls are relatively high and that of local calls are low. This unbalanced rating system makes it easier for NCCs to enter the long distance telephone market, but more difficult for NCCs to enter the local telephone market.

It can be thought that (6) Communication area limitation, (15) no policy for equal access, and (17) NTT's cross-subsidy system are caused from (7) little robust governmental policy for local competition. At the 1985 telecommunications deregulation, MPT considered well about the long distance calls competition, and reformed the environment preferable to the long distance NCCs, but it seems that MPT had not expected any entry into the local telephone market and it had little idea about the local competition. The fact that (18) there is still no regional NCC other than TTNet contributes to the current situation of (7), little policy for local competition. This undesirable situation (7) is sustained partially by the internal factor (12), TTNet's defensive strategies that cause (19) less-aggressive lobbying activities. The officially explained purpose of entry is not aggressive. These factors generate the third feed-back loop.

Furthermore, an internal factor (4), TTNet's odd scale network, generates a political dilemma which causes issue (7), little policy for local competition. If TTNet's telecommunication network were small, MPT might protect their initial entry according to its principle. However, it has potential to provide both local telephone service (intra-city) and long distance telephone service (inter-city and inter-prefecture). If all restrictions were removed, TTNet might grow into a giant company as large as NTT. Because such a situation would significantly affect the growing long distance NCCs, and also because MPT has been considering about breaking up NTT, MPT cannot allow too powerful a regional telecommunications company to evolve.